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Supreme Court Holds NRA Codes Invalid

IN A MANNER reminiscent of a Jack Dempsey finish, the Supreme Court on May 27 dealt three blows to the New Deal Administration, declaring two acts of Congress unconstitutional and reminding the President that he does not have unlimited powers to remove appointees from office.

Of primary interest to the mining industry is the declared unconstitutionality of the National Industrial Recovery Act on two grounds—the attempted delegation by Congress of legislative authority to industrial groups and the President, and the attempted regulation of intrastate matters, such as hours and wages, which affect interstate commerce only indirectly. The unanimous decision effectually demolishes the NRA code structure. It will also give pause to Congress in the framing of pending New Deal legislation that is loosely drawn and of doubtful validity.

In the confusion of the moment we revert to a thought previously expressed in these columns, and one that has gained currency in industrial and official circles. Natural-resource industries are in a different category from manufacturing and merit governmental sanction for self-regulation in the interest of stability and conservation. Never was a national mineral policy more badly needed. Fortunately, the groundwork has been laid by a national committee, and it is to be hoped that sane measures will soon be taken to effectuate a sound policy under which metal producers can continue to cooperate on a voluntary basis. Gains have been made under codes, particularly in the copper industry, that should not be lost.

Soviet Gold— Statistical Puzzle

HOW MUCH GOLD is being produced by the U.S.S.R.? What are the gold resources of that country and what ultimately will be her relative position among the gold-producing nations of the world? Exact answers to these questions are not known, principally because Soviet authorities will not —or at least do not—make them public. Economists and financial and monetary authorities wish they knew, but they are still obliged to content themselves with vague official claims or with figures expressed in terms of percentage achievement of a "plan." What a boon it would be to statisticians if the U.S.S.R. would conform to the custom of other nations and report gold production periodically in fine ounces or other standard weights. Until that happy day arrives, however, figures on Soviet gold production, other than those of the Soviet itself, will continue to carry the familiar question mark or a footnote expressing doubt and uncertainty in the mind of the statistician. That there is gold aplenty in the U.S.S.R. there is no doubt. But how much is being produced? So important a factor in the world's gold mining industry should not continue indefinitely to withhold information so freely given by the other nations of the world.

Nevertheless, an approach to accuracy can be made in ascertaining Soviet gold production. We publish in this issue the most authoritative statement on the subject that we have been able to discover. It reveals a substantial output of the precious metal—enough to give the U.S.S.R. second place in the list of gold-producing nations, dropping the United States and Canada to third and fourth places, respectively. Obviously, the record had to be built up by a painstaking process of correlating official statements and figures often widely separated as to time and source, and integrating them into credible statistics comparable with those of other countries. The necessity of such a procedure is regrettable, and we express the hope that Soviet officials will see fit to remove doubt and speculation regarding their gold production. Forthright publication of accurate statistics would be quite as much to their economic advantage as is the present policy of secrecy and indirection.

Definite Data on Transvaal Gold

IN CONTRAST with the vague figures on Soviet gold production are the definite data on South Africa published by the Transvaal Chamber of Mines. They give a clear picture of the production, value, cost, profit, and the influence of the price of gold on mining operations. Producing mines substantially

increased their tonnage, but the yield of gold showed a decrease, resulting from treatment of a lower grade of ore. The change that has come over the industry is shown by a striking comparison between 1932 and 1934 operation figures. Tonnage milled increased by nearly five million tons, or 13.8 per cent; but the grade fell off 20.6 per cent and gold production 9.4 per cent. At the same time the value of gold won increased 45.2 per cent and working profit rose more than 100 per cent. Working costs, salaries, and wages rose substantially, but did not prevent an increase of 88.9 per cent in dividends. The Government's income from leases and higher taxation increased more than 200 per cent. In its entirety the Transvaal report is a model summary of the industry.

Engineers Cooperate for Professional Advancement

A HAPPY AUGURY for the future of engineering, for improving the quality and enhancing the status of engineers, is found in the growing spirit of unity and cooperation among representative bodies of the profession in dealing with matters of mutual interest. The point was emphasized last month at a joint meeting in New York of the boards of the Founder Societies of civil, mechanical, electrical, and mining and metallurgical engineers, and their joint functional organizations. Engineers fraternized as members of a single profession, not as representatives of a specialized branch, and reviewed the work of eight joint organizations of national scope in which the Founder Societies have participated successively since 1904.

The list of joint activities is impressive in the variety and scope of engineering interest and service—research, education, employment, professional development, and public welfare—leaving no room for doubt of the importance of engineers and engineering in the national life. United Engineering Trustees, Inc., administers the joint real estate and financial affairs of the Founder Societies. Engineering Societies Library is the largest maintained by any professional organization, 145,000 volumes, and has a world-wide reputation. Special facilities are provided for engineers living at a distance from New York.

Research in engineering, science, and industry is promoted by Engineering Foundation and by the Division of Engineering and Industrial Research of the National Research Council. The former is endowed and broadly chartered for research in engineering, including its economic and human aspects. The latter is closely related to industry—encouraging, initiating, and organizing industrial research and serving as a clearing house of research information. A complementary body is American Standards Association, organized to develop national industrial standards. More than 200 standardization and safety code projects are under way or in process of revision.

In their relation to governments, state and national, engineers are represented by American Engineering Council. It furthers the public welfare wherever technical and engineering knowledge and experience are involved. One has only to consider the ramifications of science, technology, and engineering in current governmental activities to visualize the potential service of this organization to engineers and the nation.

The employment of engineers is the concern of Engineering Societies Employment Service, which has been a joint activity of the Founder Societies for twelve years. With offices in New York, Chicago, and San Francisco, it has placed nearly 14,000 engineers in positions of importance and responsibility. Finally, and latest among the joint organizations, is the Engineers' Council for Professional Development. Its objective is to enhance the professional status of the engineer, beginning with the selection and guidance of prospective students, cooperating with engineering schools in establishing high standards of education, suggesting means of post-college personal development, and finally establishing criteria for recognition of the engineer as a professional man.

All of these joint activities are to the credit of engineers in their efforts to set high standards for the profession and gain recognition of their place in the national life and their work for the public welfare.

Assessment Work Suspension A Hardy Annual

JUNE, in the last decade or more, has come to be marked by pleas to Congress to suspend the requirements of the United States mining law as to the performance of annual assessment work on claims for the respective current fiscal year. So often has this grace been extended that many persons have seemingly come to look upon it as a matter of right instead of privilege. This year the ceremony of presenting the appropriate measures before both houses well in advance of the end of the fiscal year, with the apparent intention of pushing them through at the last moment, seems to be progressing in the usual manner. Identical bills have already been introduced in both Senate and House providing for such suspension, the number of claims being limited in each case and only those individuals or companies being eligible who can claim exemption from payment of Federal income tax.

Few will object to any leniency shown by Washington to deserving but distressed claim holders, especially in view of all that is happening elsewhere. One may hazard a guess, however, that for every claim or group of claims held in deserving hands, a large number are and for years have been in the possession of companies or individuals who hope eventually to profit from them without really trying to improve them—a contingency not contemplated by the framers of the law, who had thought to facilitate the exploitation of the country's natural resources by their liberality.

To distinguish between claim holders who wish to make a mine and those who have little intention of doing so is practically impossible. Some amendment of the law is well in order whereby the holder of a claim would be required to show material progress toward making a mine within a certain time, or else give up his ground. The way would then be open to its relocation by others with better will or means to explore the area. Some new mines would probably result.

Surface plant of the Sunshine Mining Company, on Big Creek, 6 miles from Kellogg, Idaho.

In the distance at the left are the old and new mills and the dry house. Under the shed in the center is the mine supply track on the main tunnel level. The timber-framing shed is in the lower right. From it an incline leads to the supply track

Sunshine Mine Increases Silver Output By Improving Practice

J. T. Shimmin

Consulting Metallurgical Engineer and Manager, San Juan Metals Corporation Telluride, Colorado

Mill Rebuilt and Modernized . . . Fine Grinding and Flotation Adopted . . . Stoping Method Changed to Reduce Dilution

THIS PROPERTY, *in the Coeur d'Alenes, in northern Idaho, is probably the biggest producer of silver in the United States today. Dry tons milled daily have been boosted from 298 in 1934 to 399 in 1935, with an increase in the head assay from 32.7 to 38 oz. and a reduction of the metal in the tailing from 1.24 to 0.74 oz.*

WHAT is probably the largest producer of silver in the United States today—the Sunshine mine—is located on Big Creek, approximately two miles south of the Coeur d'Alene River, in the center of the "south-side" silver belt of the Coeur d'Alene mining district, about six miles from the town of Kellogg, in Shoshone County, Idaho. Its productive vein occurs in a fissure zone several hundred feet in width. The vein branches above the 1,500 level, gradually diverging until the 500 level is reached, when it again splits. Above the adit tunnel level the mineralization is very wide and ore occurs only in bunches and short shoots. Below the 1,500 level the vein is wider, and it gets richer as depth is attained. Gangue is siderite and quartz. Ore mineral is principally tetrahedrite (gray copper), with some galena, pyrite, and arsenopyrite. Country rock is talcose schist and sericitic quartzite.

This mine was originally located by the Blake brothers, who mined and shipped small lots of silver from narrow shoots and stringers near the surface outcrop of the wide shear system, typical of the Coeur d'Alene producing veins. The original Blake prospect, after several years, was converted into a leasing company, and the veins were opened up by an adit tunnel. This adit tunnel is 1,700 ft. long and is driven in from Big Creek. The shear zone was cut by the tunnel and the quartz siderite veins were opened up 500 to 600 ft. in length. Two of the veins in the shear zone carried narrow shoots of gray copper, with some galena of profitable grade. On the strength of the ore developed from the crosscut tunnel the leasing company built a small gravity concentrator. This mill was not successful; only a small tonnage of concentrate was marketed. Crude-ore shipments were the chief financial support at this time.

In 1916, the original Blake property, and all the improvements made by the leasing company, together with some adjoining ground, were organized into the present Sunshine Mining Company. The new company added fine grinding and flotation to the old gravity mill and continued development work, so that by the end of 1934 production had been gradually increased to approximately 300 tons daily.

Ore extraction up to the end of 1934 was accomplished entirely by the rill stoping system, which resulted in great dilution, the mining width of the ore ranging from 4 to 13 ft.

Frank Eichelberger, well known as consulting mining engineer and a successful manager, made a special report on the Sunshine property late in the summer of 1934. Following this examination he was engaged as consulting engineer by the Yakima office, and on Jan. 1, 1935, assumed complete charge as vice-president in charge of operations. On the same date he engaged my services to assist him in increasing production and to take charge of all metallurgical work, including the design and construction of the new mill. The old plant that had been added to from time to time, as the tonnage was increased, had become difficult to operate and expensive as well.

Mine operation is conducted through an incline shaft dipping at an angle of 65 deg. from the adit level to the 1,900 level and through a vertical prospect shaft extending from the 1,900 to the 2,300 level.

Steps were immediately taken to reduce the dilution of the ore, and, where conditions were favorable, horizontal cut-and-fill stopes (flat-back stopes) were started, particularly in new ground. Some stopes, which had been left because of their high iron content, which in the

old mill affected the grade of concentrates, were reopened and mined.

The work of rebuilding the mill along lines formulated late in 1934 by Mr. Eichelberger was started Jan. 5 and completed March 28. The plant as it is today is modern and complete in every detail and is unique in that the fine-grinding and flotation departments are housed in a building 33 ft. wide by 55 ft. long, this at the same time leaving ample space around all machines and thus making operation and maintenance easy. Visibility is exceptionally good, it being possible to observe all machinery from one point.

Fine grinding is effected in two units, each consisting of a ball mill working in closed circuit with a classifier. The ball mills, classifiers, Wilfley pumps and filter, shown in the flowsheet, are all on the main floor level. The 12-cell 24-in. Denver Equipment Sub-A flotation machine, 50-ft. Shimmin-Hirsch air flotation machine, flotation reagent feeders, conditioner tank, and motor-starting equipment are on an elevated floor. All walkways on the elevated floor are latticed to eliminate shadows from the lighting system. Indirect lighting is used very effectively throughout.

The general arrangement of equipment is shown in Fig. 1. Fig. 2 is a vertical section through the mill looking north. Both are drawn approximately to scale. Fig. 3 is the flowsheet of the new crushing and fine-grinding departments, with the legend. Fig. 4 is the flowsheet of the flotation and concentrate handling system, with legend.

Ore is delivered to the mine ore bin by storage-battery locomotives in trains of eight 2-ton cars each. From the bin it is fed onto a 30-in. conveyor belt by means of seven Coeur d'Alene Iron Works reciprocating pan feeders. The conveyor discharges onto one 3x4 Tyler Niagara screen having a $\frac{3}{4}$x1$\frac{1}{2}$-in. opening; the oversize flows to one 7-in. Traylor gyratory crusher, set at $\frac{3}{4}$-in. The product of the latter, together with the undersize of the screen, discharges onto one 24-in. incline conveyor, which in turn discharges onto a second similar conveyor that discharges into the mill ore bin. This bin has a capacity of 400 tons' available storage. It is necessary to operate the crushing department only eight hours out of the twenty-four to supply the mill on the present basis of 400 tons per day.

Ore is fed from the mill ore bin by two size C-26 Hardinge belt weighing feeders, discharging by gravity to two 8-ft. x 48-in. Hardinge ball mills. No. 1 mill operates in closed circuit with one 36-in. double-spiral submerged type Akins classifier of the latest design; the No. 2 mill operates in closed circuit with one 6x22-ft. heavy-duty duplex Dorr classifier. The combined ball-mill feed averages 80 per cent solids; the classifier overflow 30 per cent solids and 5 per cent plus 100 mesh. Overflow from both classifiers goes to two 4-in. direct-connected

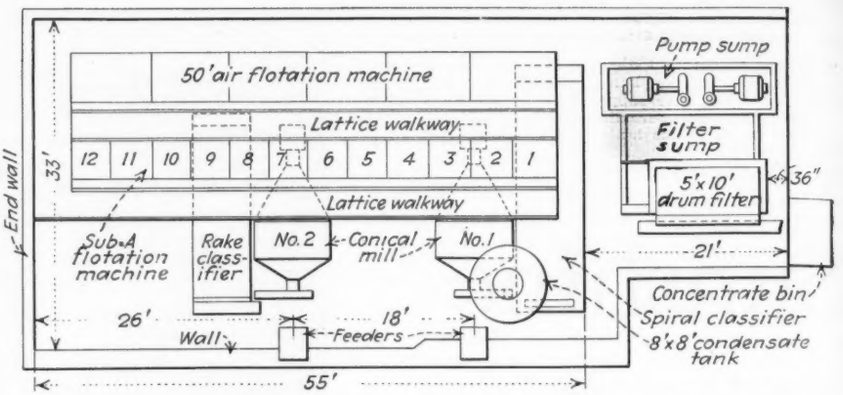


Fig. 1—Plan view showing the layout of the grinding and flotation section. Ample space is allowed around each machine, facilitating operation and repair

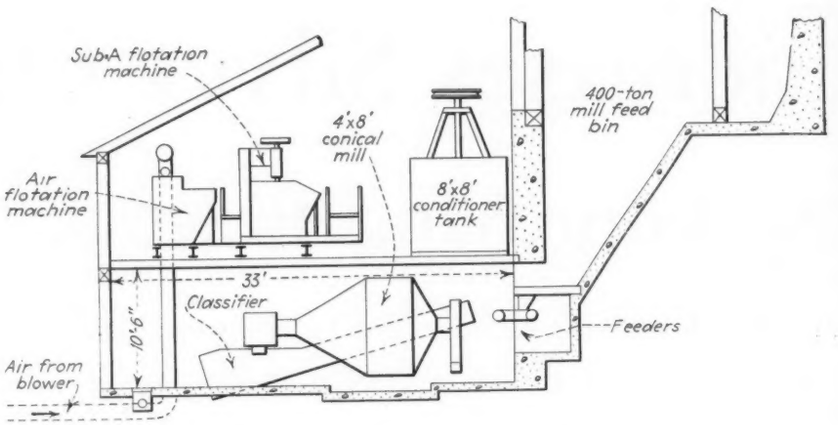


Fig. 2—Elevation of the grinding and flotation section with the mill feed bin from which the grinding mills are supplied

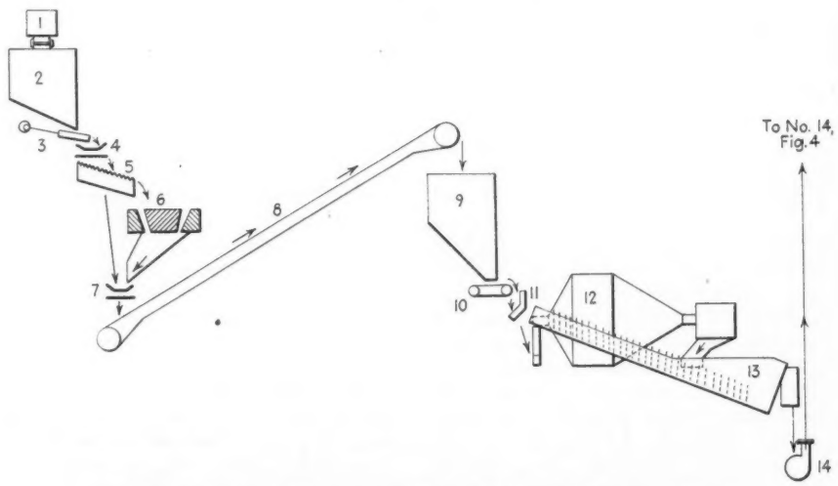


Fig. 3—Flowsheet of the new crushing and fine-grinding departments

Legend

1. Mine cars—2 tons' capacity
2. Mine ore bin—300-ton capacity
3. Seven Couer d'Alene Iron Works feeders
4. One 30-in. conveyor belt, 57 ft. center-to-center, equipped with Dings magnetic pulley and 3-hp. variable-speed motor
5. One 3x4-ft. Tyler Niagara screen $\frac{3}{4}$x1$\frac{1}{2}$-in. opening, 3-hp. motor
6. One 7-in. Traylor gyratory crusher, $\frac{3}{4}$-in. product, 75-hp. 900-r.p.m. motor
7. One 24-in. 58-ft. center-to-center belt conveyor, inclined 23 deg., 220 f.p.m., 3-hp. motor.
8. One 24-in. 25-ft. center-to-center belt conveyor, inclined 21 deg., 115 f.p.m., 3-hp. motor.
9. Mill ore bin, 400 tons' capacity
10. Two Hardinge belt weighing feeders, size C26
11. Two electrically operated head samplers
12. Two 8x48-ft. Hardinge ball mills, 200-hp. motor each
13. One 6x22-ft. Dorr rake classifier and one 36-in. double-spiral Akins classifier
14. Two 4-in. Wilfley pumps, one spare

Wilfley pumps, only one of which operates at a time. These discharge to one 8x8-ft. conditioner tank, from which the pulp goes to a 12-cell Denver Sub-A flotation machine and a Shimmin 50-ft. air-lift type machine operating in series.

The flotation feed is introduced into the No. 2 cell of the Sub-A machine where a finished concentrate is made. Concentrates from Nos. 3, 4, and 5 cells are returned to No. 1 cell, which also produces a finished concentrate and cleaner tailing, the latter joining the original feed. Concentrates from Nos. 6, 7, and 8 cells are returned to No. 3 cell and concentrates from Nos. 9, 10, 11, and 12 and all of the air-cell concentrates return to No. 6 cell of the Sub-A machine. Tailings from the last cell of the Sub-A machine flow to the head of the 50-ft. air-lift machine, which makes the final tailings sent to waste. Finished concentrates contain an average of 60 per cent solids and flow by gravity direct to one 5x10-ft. Oliver filter, which produces a cake containing an average of 5½ per cent moisture. Mill heads, finished concentrates, and final tailings are sampled with electrically operated mechanical samplers cutting the streams at intervals of nine minutes, all actuated from one central electric timing mechanism.

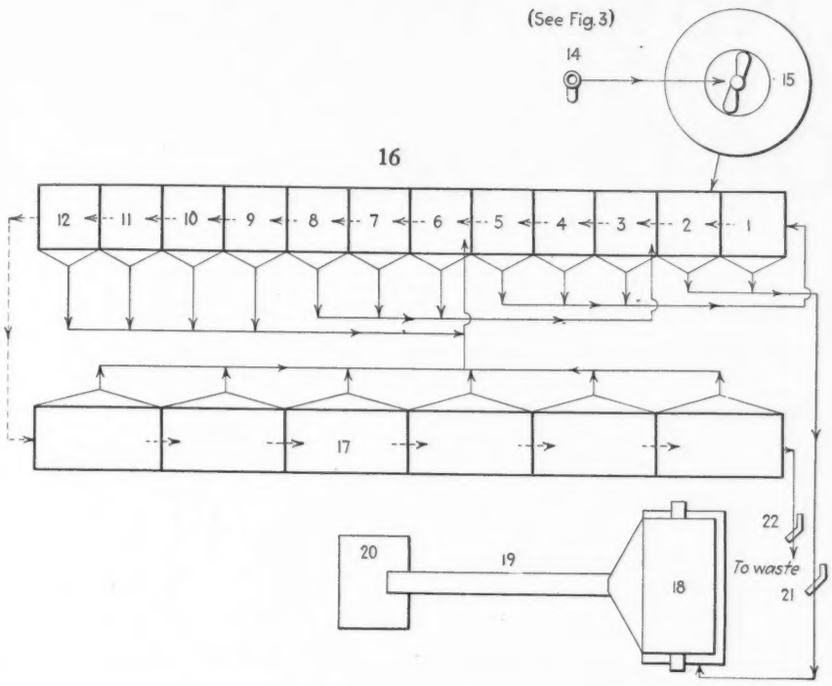


Fig. 4—Flowsheet of the flotation and concentrate handling system

15. One 8x8-ft. conditioner tank
16. One 12-cell Sub-A flotation machine
17. One 50-ft. Shimmin-Hirsch air cell
18. One 5x10-ft. Oliver filter
19. One 14-in. conveyor inclined 27 deg.
20. One 85-ton concentrate bin
21. One electrically operated concentrate sampler
22. One electrically operated tailing sampler

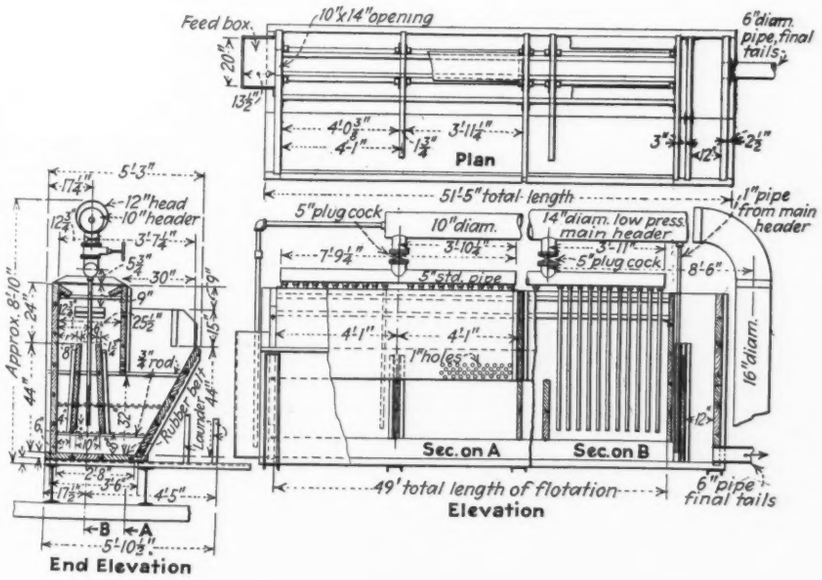


Fig. 5—Side and end elevations and plan of the Shimmin air-flotation machine, patented. At the Sunshine mill this is used for treating the tailings from the 12-cell Denver Sub-A machine

Fig. 5 shows the Shimmin air-flotation machine, which is of patented design, in plan, elevation, and section. In this plant this machine is used for re-treating the tailings from the 12-cell, 24-in. Sub-A machine, and resulted in a marked improvement in recovery, as well as simplicity in operation. The air required to operate the Shimmin machine averages 4,500 cu.ft. per minute at 1¾-lb. pressure per square inch, or 90 cu.ft. of air per minute per foot of cell length. The air cell is level and requires less than one foot fall between the tailings discharge elevation of the Denver Sub-A machines and the feed inlet to the air machine.

Tonnage and metallurgical results for the year 1934 with the old mill in operation averaged as given in Table I.

Table I—Mill Results for 1934

Dry Tons Milled per Day	Heads Assay, Oz. Ag	Tails Assay, Oz. Ag	Concentrate Assay, Oz. Ag
298	32.7	1.24	823.0

The foregoing results may be compared with those in Table II for 21 days of April, 1935, when the new mill was in operation and when treating somewhat more difficult ore due to higher iron content.

Table II—Mill Results for 21 Days of April, 1935

Dry Tons Milled per Day	Heads Assay, Oz. Ag	Tails Assay, Oz. Ag	Concentrate Assay, Oz. Ag
399	38.0	0.74	884.9

The flotation reagents are all fed mechanically with Kraut oil feeders and special constant-level feeders, which were designed by Jake Schroder, mill superintendent. Aerofloat No. 25, Barrett No. 4, coal-tar creosote, and Minerec A are fed to the ball mill and a small quantity of pine oil is fed to the eighth cell of Sub-A machine. Sodium cyanide and lime are fed to the cleaner, or No. 1 cell of the Sub-A machine, to depress the iron. The total reagent cost averages $0.04 per ton milled.

Natomas' Newest Dredge Has Novel Points Of Design

Built for Staunch Service and Operating Economies

FEATURES

1. **Direct-driven bucket line; individual winches for bow lines and ladder hoist**
2. **D.c. power for bucket-line motors and bow-line winches**
3. **Air-operated brakes on winches for stern line and ladder hoist**
4. **Pushbutton starting; automatic control**
5. **Electric cranes for repairs and maintenance**
6. **Speed reducers on all mechanical units**

John B. Huttl
Assistant Editor, San Francisco, Calif.

REPRESENTING the latest in design and equipment, the new 16-cu.ft. all-steel dredge recently completed at Salsbury, about 6 miles west of Folsom, Calif., by the Natomas Company, was started up on April 18, 1935. With actual laying of steel starting on Oct. 18, 1934, followed by the launching of the hull on Jan. 12, 1935, the total time required to build the new boat was exactly six months. In its design, based on years of experience in construction and operation of gold placer dredges, Natomas engineers have spared no efforts to obtain reliable service and economies in operation.

Outwardly, the new unit seems identical in appearance to the other dredges operating in the district, but upon closer inspection of the interior several features new in dredge construction will be apparent to the visitor. Among these are (1) a direct-driven bucket line and individual bow-line winches and ladder hoist winch; (2) a power plant in the interior of the hull to generate direct current for the motors driving the bucket-line and the bow-line winches; (3) air-controlled brakes on the stern-line winch and ladder-hoist winch; (4) exclusive employment of pushbutton starting and automatic-control equipment; (5) installation of electric traveling, jib, and trolley cranes to facilitate repairs and the removal of worn parts; and (6) use of speed reducers for driving all mechanical units.

Combination of double stackers and dewatering sand wheels, which is made use of in the new dredge, is not new. Their use affords a means, in conjunction with the requisite process of handling the gravels to recover the precious metal, of redepositing the material more uniformly and with less resultant swell behind the dredge and also of leaving the finer sands and gravels on the top instead of the bottom, as is usual with ordinary dredge practice.

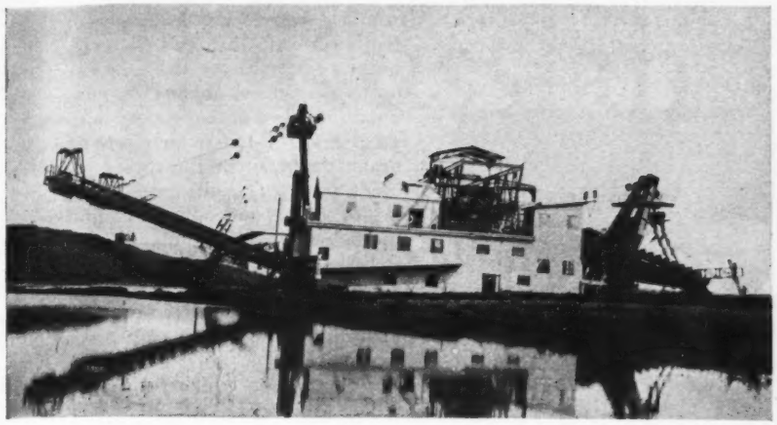
Capacity of the new unit will be 500 cu.yd. or more per hour, and the maximum dredging depth is 30 ft. below water. The dredge has cost about $400,000. The steel hull is 114 ft. long, 54 ft. wide on the water line, and 11 ft. deep. It is built of plates, angles, and channels stiffened by two girders, one on each side of the well hole, running the entire length of the hull, and by three bulkheads, which divide the hull into fifteen water-tight compartments, each equipped with an hydraulic ejector. The deck, upon which are mounted the superstructures and operating equipment, is 64 ft. wide, including a 5-ft. overhang on each side. Total weight of the hull and superstructure is about 575 tons.

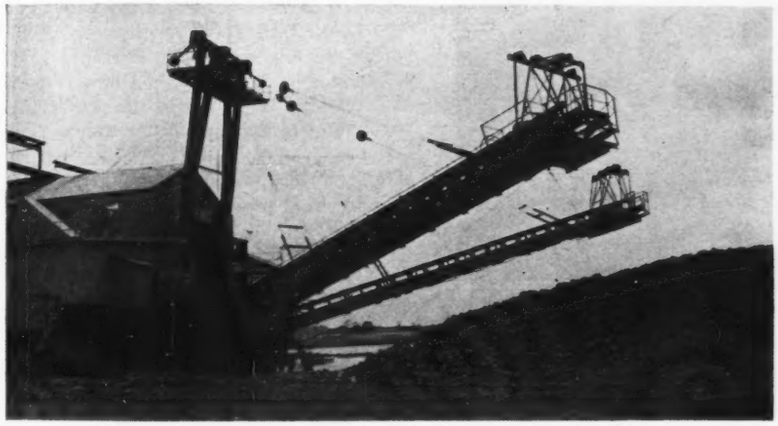
Both bow and stern gantry, constructed of plates, angles, and channels, are of standard design. The former is four-legged, standing in four separate deck footings built on foundations extending from the floor of the hull to the deck. Upon the stern gantry are mounted the suspension accessories for handling the spud in the center line of the stern and the two tailings stackers. The spud is 30x42 in. in section, 61 ft. long, working against a self-aligning kick casting. It is operated by the stern-line winch, which also handles the spare and stern lines.

No changes have been made in the design of the digging unit, consisting of bucket lines, digging ladder, and accessory equipment. The digging ladder, upon which the bucket line operates, is of the plate-girder type and measures 87 ft. between bucket tumblers. Two bearings on the upper tumbler shaft support the elevated end of the ladder. The one-piece idler in the well hole is 9 ft. in diameter. On the bucket line there are 62 manganese buckets, each of 16-cu.ft. capacity. The bucket lips are of the inside-outside type, riveted in place, and the pins are 6¼ in. in diameter, of forged nickel-chrome steel, heat-treated, and made at the company shops at Natoma. The lower tumbler, 5 ft. 7 in. in diameter, is a two-piece manganese-steel casting. Its companion, the upper tumbler, is hexagonal in shape, of high-carbon chrome steel, shrunk on a nickel-steel shaft, and provided with forged and heat-treated nickel-chrome heel plates.

The arrangement of the bucket line's drive mechanism is new in dredge construction. Two large machine-cut spur gears mounted on the upper tumbler shaft are driven by two Farrel speed reducers, respectively, each powered by two 150-hp. d.-c. motors connected in series. Flexibility of operation is apparent when considering the inherent speed control characteristics of direct-current motors, which in this case permit variations in bucket speed from 18 up to 30 buckets per minute.

Direct current for the aforementioned motors and the 60-hp. bow-winch motors is supplied by a 500-hp. motor-generator set driven by an 80 per cent leading power-factor synchronous motor, which provides enough corrective effect to operate the entire dredge at approximate unit of power factor. This high power factor permits taking ad-

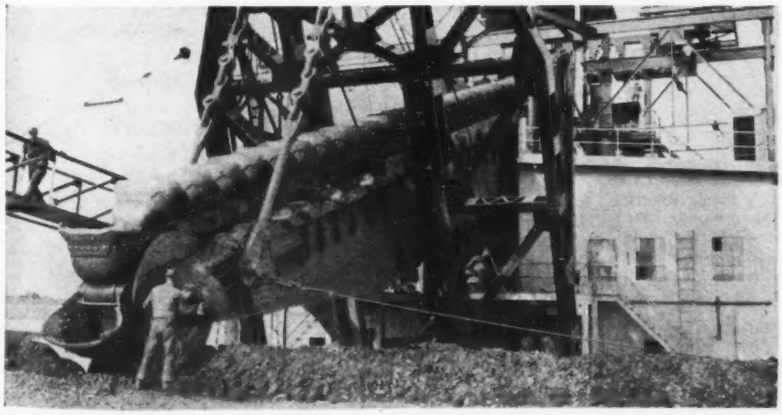




TOP—Natoma No. 1 gold placer dredge, which began digging gravel at Salsbury, Calif., on April 18. It is of all-steel construction and handles 500 cu.yd. per hour, its maximum dredging depth below water level being 30 ft. It cost $400,000 and was built in six months. In this illustration the digging ladder is seen elevated while the dredge is being stepped ah ad

ABOVE—The stern of No. 1 dredge. The double stackers receive the tailings from dewatering sand wheels, thereby being enabled to deposit them more uniformly and with less resultant swell behind the dredge, at the same time leaving the finer material at the top instead of the bottom

BELOW—Digging ladder and bucket line. The former is of the plate girder type and is 87 ft. long between tumblers. It carries 62 16-cu.ft. buckets, of manganese steel. The lower tumbler, here seen being greased, is a manganese-steel casting, 5 ft. 7 in. in diameter. The upper tumbler is hexagonal in shape and of high-carbon chrome steel, shrunk on a nickel-steel shaft



vantage of the power company's power-factor rates and results in an over-all saving of 5 per cent of power cost. Variable voltage control is used in order that no power be wasted in resistance, and speed control is positive and very flexible. In addition, the characteristics of the motor-generator set are such that in the event of trouble and excessive overloading of the motor, the voltage will drop to zero with only 50 per cent overload current circulating in the system. Obviously, no overload trips are necessary in the circuit with this type of control. Save for the fact that torque-adjusting rheostats are available in the pilot room, which enable the winchman to adjust the pull on the lines and the speed with which the dredge is moved across the pond, the control of the bow-line winches is identical to that of the bucket-line drive.

The hopper, which receives the material discharged from the buckets, is of the same general design as used on the other Natoma dredges and is built of ¼-in. shell plate and ⅜-in. liners. Gravel escaping this hopper is practically all caught by the save-all. With the exception of a special drip pan to prevent oil and grease from entering the save-all sluices, this unit, too, is of standard design. It contains the conventional grizzly bars and a system of sluices to classify and convey the material to the well hole, at the after end. The revolving screen is driven by a 75-hp. speed-reducer unit, measures 9 ft. in diameter, 36 ft. center to center of tread rings, and 45 ft. 2¾ in. in over-all length. Of the four screen sections used, one contains ¼-in. perforations, and the others ⅜-in. and ½-in. Undersize screen discharge is collected below the revolving screen in a steel distributor. This differs somewhat from the distributors used on the other dredges in the Folsom field, in that it is open on one side to provide easier access and facilitate adjustments to water valves and gold tables.

From the distributor the material flows over a system of gold-saving tables and sluices arranged on either side of the revolving screen. The table area is divided into eleven sluices, and the tail sluices number eight. All sluices are 2 ft. 8 in. wide, and are equipped with standard double riffles and mercury trap riffles at strategic points. The double-riffle arrangement provides a total sluice area of 5,500 sq.ft. Tailings flow to the steel sumps of two dewatering sand wheels at the stern. These wheels, 13 ft. in diameter, have twelve lifting buckets and are driven by a 10-hp. speed-reducer unit through a chain drive. The sand flows by gravity to the stackers, and the sump overflow can either be passed over sluices direct to the pond or pumped through the 6-in. pipes installed at one side of each stacker and used for leveling tailings. To simplify clean-up operations, two steel sumps have been provided at the discharge end of the tailing sluices. Into

these are conveyed the riffle contents for further treatment in a long tom and a small jig, both fed by a bucket elevator.

The two tailings stackers are of the girder type, and are 92 ft. long. Each is provided with a 42-in. rubber belt, Link-Belt anti-friction pulleys and idlers, and a drive mechanism consisting of motor-driven speed reducers on both ends of the drive pulley. The motors develop 30 hp. each, and one motor is sufficient to operate the belt. Normally, they operate in parallel. Control, as already stated, is by pushbutton. Distribution of gravel from the stacker hopper is regulated by two built-in steel swing gates through which the gravel can either be passed over a rock chute direct to the pond or to one stacker or both stackers.

Much thought has been given to the selection and installation of electrical equipment. Electric power is delivered to a central control room in the center of the hull at 2,300 volts by a submarine cable. Here are housed the motor-generator set supplying direct current to the two 150-hp. motors on the bucket-line drive and the 60-hp. motors on the bow winches; a switchboard for the 2,300-volt motors; and a smaller one for the 440-volt equipment. Near by on deck is a specially constructed asbestos-lined vault containing transformer sets to step down from 2,300 to 440 volts, and from 2,300 to 220/110 volts for lighting purposes.

The 2,300-volt equipment includes the 150-hp. ladder-hoist motor; 75-hp. stern-winch and spud-hoist motor; the 75-hp. revolving-screen motor; the 150-hp. high-pressure pump motor; the 60-hp. low-pressure pump motor; the 60-hp. motor on the pump supplying water for sluicing out the digging ladder and the hoppers; and the 150-hp. spare-pump motor.

On the 440-volt circuit are the four 30-hp. motors driving the two stackers; two 10-hp. motors on the dewatering sand-wheel drives; two small motors on the revolving screens on the pump intakes; two motors driving the air compressors of the Westinghouse air-brake system; and the electric cranes.

Equipment to facilitate repairs consists of two 5-ton jib cranes on the forward deck for changing bucket pins and bushings; a 5-ton jib crane on the forward upper deck for repairs on the digging ladder; a 15-ton traveling crane operating on tracks extending the full width of the hull for the upper tumbler and drive mechanism; and small trolley cranes above the winches and hoists.

The stern winch is equipped with air-operated brakes and clutches. These are actuated by magnet valves and push-buttons in the pilot house. Signal lights show the winchman the exact position in which each clutch is set. The stern winch also handles the spud, and the arrangement is such that when the spud reaches the desired height it touches a contact, which automatically cuts the motor off the line and sets the spud brake. This leaves the winchman free to do other work during stepping-ahead operations. Another safety measure is an overspeed trip which sets the spud brake the moment the motor speed exceeds practical limits.

In the pilot house of No. 1 dredge. Here may be seen the control equipment for the various winches, hoists and gravel-washing machinery installed on the boat

Looking up one of the two tailings stackers. Each is of the girder type, 92 ft. long and provided with a 42-in. rubber belt. Note the twin speed reducers on the drive pulley

The brake and control equipment on the ladder hoist is similar to that of the stern winch. Here the overspeed trip is a Lilly hoist controller, which cuts off the motor and sets the brake when the lowering speed exceeds practical limits. In addition, the hoist contains an electric depth gage which records the work of the digging ladder upon a revolving chart installed in the pilot house within view of the winchman. The pilot house also contains a meter which indicates the bucket-line speed; ammeters on the direct-current circuits to show the load; a voltmeter on the 2,300-volt circuit to indicate the condition of the power supply; control equipment for the various winches, hoists, and gravel-treating machinery; and an emergency trip button to cut off all power except that needed for the fire pump and lights. All control devices are mounted in the central control room. The air there is kept constant by a small air-cooling unit.

The lighting problem has been solved satisfactorily by placing two 500-watt floodlights upon the bow gantry, one 1,000-watt light upon the bow housing, two 1,000-watt lights upon the stern housing, two 500-watt above the stacker belts, and one 500-watt light at the end of each stacker.

Pump equipment consists of one 14-in. high-pressure centrifugal pump; one 14-in. low-pressure pump; one 8-in. monitor pump; and a 14-in. stand-by unit, which, owing to the variable-speed drive, can be used for either of the three operating units. All pumps are direct-connected to respective motors. Suction inlets are provided with Link-Belt revolving screens to protect against floating trash. This is new in dredge practice.

The housing of the dredge differs considerably from that used on the other dredges. It is an all-steel structure with corrugated-iron siding containing a generous number of windows to make the interior of the housing as light as possible. The main roof or upper deck is of $\frac{3}{8}$-in. steel plate, butt-welded and spot-welded to partitions. Screen house roof, main-drive crane roof, and winch-room roof are of corrugated iron. Aluminum paint was used exclusively for painting the interior. The complete structure is safe and fireproof.

Officers of Natomas Company are: Thomas McCormack, president and general manager; A. L. James, secretary; R. G. Smith, manager of the gold-dredging department. Leland S. Rosener, consulting engineer of San Francisco, in cooperation with the operating and engineering departments of Natomas Company, was responsible for working out the details of this dredge.

Russian Gold*

Approximately $150,000,000 Produced in 1934, An Increase of Almost 60 per Cent Over the Year Before

Study of Available Evidence Points to an Output of 4,262,672 Oz. as Correct

◆

GAIN is ascribed to

1. **Extension of summer operations well into the fall.**
2. **Rapid expansion of production in the Urals, due in part to new discoveries**
3. **Progressive mechanization of mining**
4. **A greater number of laborers**

◆

THOUGH the production of gold in Soviet Russia is treated as a state secret, and no exact information is available concerning the production of this metal in the last few years, certain figures were published in 1934 which throw more light on the subject than was available to the public a year ago.

Two statements appeared in the Soviet press which are usually quoted as a basis for calculating the output of gold in 1933. One is by Stalin in an interview with Walter Duranty on Dec. 25, 1933,[1] that Soviet gold production in 1933 was valued at more than 100,000,000 gold rubles. The other is by A. P. Serebrovski, Chief of Glavzoloto (Chief Administration of the Gold Industry of the U.S.S.R.),[2] that Soviet gold production in 1933 was larger than either the American or Canadian production, which, according to him, amounted to 78,000 and 84,000 kg., respectively.

Through lack of more exact information, Soviet gold production is usually calculated on percentage figures published in the Soviet press, showing the increase in production in the respective year, in comparison with the preceding year. In this way it was calculated that the output of gold in the U.S.S.R. amounted in 1932 to 61,900 fine kilograms. The increase in production in 1933 was estimated, at the beginning of 1934, at 41.5 per cent.[3] From this it has been calculated that Soviet gold production had reached 87,588 fine kilograms in 1933, or 2,815,000 fine ounces, to the value of 98,558,000 U. S. dollars.[4]

The figure of 87,588 kg. checks with Stalin's and Serebrovski's statements—namely, that production exceeded the American and Canadian production (78,000 and 84,000 kg.), and that the value of the output exceeded 100,000,000 gold rubles.

It seems, however, that the production was actually below the figure indicated, and that both Stalin's and Serebrovski's statements were based on a preliminary estimate, which later proved to be too high.

Before going into details, it is perhaps advisable to refer to Table I, showing Soviet gold production in the last few years, including 1933, according to the preliminary estimate just mentioned.

Reference is also made to Table II, showing the gold production figures as calculated by Prof. S. N. Prokopovich, of Prague, the well-known expert on Soviet economic matters, and by the German *Ost-Express*.[5]

It will be seen from Table II that the figures given in Table I, calculated on the percentage figures showing the annual increase in production, are very close to those calculated by Professor Prokopovich, but that they differ somewhat from those of the *Ost-Express*.

Whereas there may be some difference of opinion concerning the quantity of gold produced in 1933, there seems to be little doubt, from all information available, that the output of gold in 1932 amounted actually to 61,900 kg., or was very near that figure.

Sovetskaya Zolotopromyshlennost published recently an article,[6] in which the trend of development of the gold production of 1932 was given. This trend was illustrated by percentage figures, Table III, showing the production in the various months, in per cent of the January production, the latter taken as 100.

No figure is given for December, the omission being perhaps intentional, since the publication was prepared over eighteen months after the close of the month in question. This makes it impossible to calculate the production for every month. No mistake will be made, however, in assuming that the December production was equal to or very near the January production, and it will be seen hereinafter that this is confirmed by other Soviet sources. On the basis of this assumption and the total production figure for 1932—namely, 61,900 kg.—it is possible to calculate the gold production of 1932, for each separate month—Table IV.

Recasting these figures according to quarters, we get the production shown in the first column of figures in Table V. These are confirmed by percentage figures published in *Sovetskaya Zolotopromyshlennost*,[7] showing the trend of gold production by quarters. The percentages and their corresponding kilograms appear in the second and third columns of Table V. They are very close to those given in the first column calculated from Table IV. This proves that the monthly production figures as calculated are correct, and that the assumption that the December production was equal to or very near that of January is also correct. A glance at the trend of gold production in 1932, as it appears in Table IV, shows that the December decline in production is a recurring seasonal event. It will be seen later on in this article that the low level of gold production in December continued during the first months of the next year—in other words, throughout the whole winter season 1932-1933.

The calculation of Soviet gold production for each separate month and per quarter of 1932 is important in so far as it permits a more exact calculation for 1933 and 1934 than was heretofore possible.

The Soviet authorities continued in 1933 their policy of publishing only percentage figures showing the increase in production in comparison with that of the preceding year.

An article by D. I. Steinbock[3] gave the percentage figures showing gold production in per cent of the 1932 output (Table VI).

On the basis of these percentage figures, and the figures arrived at in Table IV, it is easy to calculate the monthly production in 1933 (Table VII). It will be seen from this table

*Based on reports from American consular officers.

Table I—Soviet Gold Production, 1927-1933 . . . In Fine Kilograms, Ounces, and U. S. Dollars

Year	Fine Kilograms	Fine Ounces[4]	Value in U. S. Dollars[4]
1927	25,194	809,987	28,350,000
1928	27,965	899,075	31,468,000
1929	33,660	1,085,384	37,988,000
1930	44,593	1,433,665	50,178,000
1931	52,907	1,700,960	59,533,000
1932	61,900	1,990,000	69,650,000
1933 (preliminary estimate)	87,589	2,815,950	98,558,000

Table II—Soviet Gold Production, 1927-1933, From Various Sources Indicated . . . In Fine Kilograms

Years	Estimates Made in This Article	According to Prokopovich	*Ost-Express* Minimum	*Ost-Express* Maximum
1927	25,194	24,900	23,000	24,000
1928	27,965	27,600	No data	No data
1929	33,660	33,400	No data	No data
1930	44,593	44,100	40,600	43,000
1931	52,907	52,000	48,300	61,200
1932	61,900	61,800	56,500	59,000
1933 (preliminary)	87,588	87,400	84,700	88,500

Table VII—Soviet Gold Production, 1932 and 1933 . . . By Months

	1932 Kilograms —Table IV	1933 In per Cent of 1932	1933 In Kilograms
January	3,232	92.2	[a]3,232
February	3,361		[a]3,232
March	4,105		[a]3,400
April	4,137	100.0	4,137
May	5,721	100.0	5,721
June	7,530	116.7	8,787
July	7,530	126.3	9,510
August	7,337	157.7	11,570
September	6,593	180.9	11,927
October	5,624	184.8	10,393
November	3,490	215.5	7,521
December	3,240	224.0	7,258
Totals	61,900		86,688

[a]The produc ion figure for the quarter, calculated on the basis of the percentage figure, is 9,864 kg. Production in March was 22 per cent below the April production (*Sovetskaya Zolotopromyshlennost*, 1933, Nos. 6 and 7, p. 3), or 3,400 kg. Deducting this quantity from 9,864 kg., 6,464 kg. are obtained for January and February, which quantity was divided by two in order to arrive at fair estimates for each separate month.

that the total output in 1933, calculated by totaling the monthly figures, is about 900 kg. below the output given in Table I. The quarterly figures, calculated from Table VII, are given in Table VIII.

There seems to be no divergence of opinion about the correctness of the figures for the first two quarters. D. I. Steinbock states in the article mentioned in the foregoing that the gold industry functioned poorly during the first five months of 1933, and that a radical change for the better took place in June. This is confirmed by the figures to which reference has been made. An editorial in *Sovetskaya Zolotopromyshlennost*[8] states that the output of gold in the first quarter of 1933 was below the output in the corresponding period of 1932, and that in April and May the production reached the level of the corresponding months in the preceding year. This is also confirmed by the figures presented in Table VIII. It is furthermore known that the output of gold in the first half of 1933 exceeded the output in the corresponding period of 1932 by 2 per cent,[9] which fact is substantiated by the figures given in Tables VII and VIII. But whereas there is little doubt of the accuracy of the production figures for the first half of the year, there is less certainty regarding those for the second half. It seems that the percentage figures given by Steinbock, as well as those showing the increase of gold production throughout the year (41.5 per cent), were mere preliminary estimates, and that the final result was lower than originally expected. This conclusion is arrived at from percentage figures recently given by Serebrovski,[10] which substantially differ from those given early in 1934 by D. I. Steinbock (Table IX).

It will be seen from this table that Serebrovski's figures are much lower than Steinbock's. This discrepancy is easily explained. A close check of the 1933 figures shows that production was lower than the original estimates. It must be borne in mind that Stalin's statement concerning the gold production of 1933 was made in December, 1933, before the final results were known. Serebrovski's statement that in 1933 Soviet gold production had surpassed the Canadian was made early in 1934, and was apparently based on the preliminary estimates, as given by D. I. Steinbock in his article.[3]

The revised percentage figures, as given by Serebrovski in his recent article,[10] permit the calculation of the final production figures given in Table X. It will be seen from this table that the actual output of gold in 1933 amounted to only 82,958 kg., and not 86,688 or 87,588 kg., as expected.

The discrepancy between the original estimate for 1933 and the final result, shown in the preceding paragraph, is regrettable, as it complicates the calculation for 1934.

Table III—Trend of Soviet Gold Production, 1932 . . . In per Cent of January Production as 100

January	100	July	233
February	104	August	277
March	127	September	204
April	128	October	174
May	177	November	[illegible]
June	233	December	No data

Table IV—Soviet Gold Production, 1932 . . . By Months

	In per Cent of January Production	In Fine Kilograms
January	100	3,232
February	104	3,361
March	127	4,105
April	128	4,137
May	177	5,721
June	233	7,530
July	233	7,530
August	277	7,337
September	204	6,593
October	174	5,624
November	108	3,490
December	100	3,240
Total		61,900

Table V—Soviet Gold Production, 1932 . . . By Quarters

Quarters	Kilograms From Table IV	Per-centage	Kilograms
First	10,698	17.2	10,647
Second	17,388	28.0	17,332
Third	21,460	34.7	21,479
Fourth	12,354	20.1	12,442
Totals	61,900	100.0	61,900

Table VI—Monthly Soviet Gold Production, 1933 . . . In per Cent of the 1932 Output

First quarter	92.2
April	100.0
May	100.0
June	116.7
July	126.3
August	157.7
September	180.9
October	184.8
November	215.5
December	224.0

Table VIII—Soviet Gold Production, 1933 . . . By Quarters

Quarter	Kilograms
First	9,864
Second	18,645
Third	33,007
Fourth	25,172
Total	86,688

Table IX—Soviet Gold Production, Second Half of 1933 . . . In per Cent of Output in 1932

	According to D. I. Steinbock	According to A. P. Serebrovski
July	126.3	125.9
August	157.7	144.3
September	180.9	173.0
October	184.8	179.0
November	215.5	187.0
December	224.0	197.0

Table X—Soviet Gold Production, 1933. Preliminary Estimate and Revised Production Figures . . . In Fine Kilograms

	Original Estimate	Revised Estimate
First quarter	9,864	9,864
Second quarter	18,645	18,645
July	9,510	9,480
August	11,570	10,587
September	11,927	11,406
October	10,393	10,067
November	7,521	6,526
December	7,258	6,383
Totals	86,688	82,958

Table XI—Planned Gold Production, 1934 . . . In per Cent of the January Plan as 100

January	100	July	289
February	104	August	306
March	115	September	304
April	124	October	No data
May	177	November	No data
June	237	December	No data

Table XII—Approximate Production Program, 1934 . . . For the First Nine Months

	In per Cent of January Production	In Fine Kilograms
January	100	5,000
February	104	5,200
March	115	5,750
April	124	6,200
May	177	8,850
June	237	11,850
July	289	14,450
August	306	15,300
September	304	15,200

According to Quarters

	Kilograms
First	15,950
Second	26,900
Third	44,950
First three quarters	87,800

Table XIII—Soviet Gold Production . . . First Half of 1934

	Kilograms
First quarter	16,502
Second quarter	26,547
First half year	43,049

Table XIV—Soviet Gold Production . . . First Nine Months of 1934

	Kilograms
First quarter	16,502
Second quarter	26,547
First half year	43,049
July	14,172
August	14,821
September	17,931
Total	89,973

Table XV—Preliminary Estimate of Soviet Gold Production, 1934, by Months . . . In Fine Kilograms

First quarter	16,502
Second quarter	26,547
July	14,172
August	14,821
September	17,931
October	18,027
November	15,587
December (preliminary estimate)	9,000
Total	132,587

Table XIX—Percentage of Reef Gold In Total Russian Gold Production

1927–1928 (Fiscal year)	16
1928–1929 (Fiscal year)	24
1929–1930 (Fiscal year)	34
1931 (Calendar year)	37
1932 (Calendar year)	40
1933 (Calendar year)	44

Table XX — Russian Gold Production Before the War . . . In Fine Kilograms

	"Shlikhovoe Zoloto" (Black Sand)	Chemically Pure Gold
1904	43,740	37,090
1905	39,100	33,660
1906	42,780	36,800
1907	44,690	37,780
1908	49,930	42,370
1909	56,840	48,760
1910	63,700	53,680
1911	61,280	52,100
1912	58,260	47,810
1913	60,894	49,280

Beginning with the production plan for 1934, which has never been published in the Soviet press, there are various indications that it provided for a 50 per cent increase over that of 1933. *Sowjetwirtschaft und Aussenhandel* (*Soviet Economy and Foreign Trade*), organ of the Soviet Trade Delegation in Germany, for instance, states in its November issue, 1934, No. 21/22, p. 61: "The overfulfillment of the plan has been assured, and at the same time an increase in production by more than 50 per cent, in comparison with the preceding year." This 50 per cent increase referred originally to the figure of 87,588 or 86,688 kg., so that there is little doubt that the production program for 1934 provided originally for the production of about 130,000 kg. of gold. Later, when the exact output of gold in 1933 became known, the 50 per cent increase was calculated on the basis of 82,958 kg., whereby the program was automatically reduced to about 124,500 kg. This change in the production program considerably complicates matters, as the percentage figures in various Soviet publications evidently refer to two different programs, and it is quite apparent that the authors of the respective articles, when giving percentages of a particular production program, do not know to which of the two figures mentioned in the foregoing they actually refer. Many of the percentage figures referring to the plan therefore contradict each other and are misleading.

Sovetskaya Zolotopromyshlennost[11] recently published interesting percentage figures showing the production plan for the first nine months of the year (1934), in per cent of the January program as 100. It can be seen that here again the figures were not given for the whole year (Table XI).

Since the percentage figures are incomplete, it is impossible to calculate

Table XVI — Soviet Gold Production, 1927-1934 . . . In Fine Kilograms, Ounces, and U. S. Dollars

Years	Fine Kilograms	Fine Ounces	Value, U. S Dollars
1927	25,194	809,987	28,350,000
1928	27,965	899,075	31,468,000
1929	33,660	1,085,384	37,988,000
1930	44,593	1,433,665	50,178,000
1931	52,907	1,700,960	59,533,000
1932	61,900	1,990,000	69,650,000
1933	82,958	2,667,100	93,348,000
1934 (preliminary estimate)	132,587	4,262,762	149,197,000

Table XVII—Trend of Soviet Gold Production, 1930-1932 . . . By Quarters

	1930		1931		1932	
	In per Cent of Total Production	In Kilograms (Calculated)	In per Cent of Total Production	In Kilograms (Calculated)	In per Cent of Total Production	In Kilograms (Calculated)
First quarter	12.3	5,485	10.6	5,608	17.2	10,647
Second quarter	25.8	11,505	26.0	13,756	28.0	17,332
Third quarter	43.7	19,487	37.6	19,893	34.7	21,479
Fourth quarter	18.2	8,116	25.8	13,650	20.1	12,442
Totals	100.0	44,593	100.0	52,907	100.0	61,900

Table XVIII—Soviet Gold Production Since 1930, by Quarters . . . In Fine Kilograms

Quarters	1930	1931	1932	1933	1934
First	5,485	5,608	10,647	9,864	16,502
Second	11,505	13,756	17,332	18,645	26,547
Third	19,487	19,893	21,479	31,473	46,924
Fourth	8,116	13,650	12,442	22,976	42,614
Totals	44,593	52,907	61,900	82,958	132,587

Table XXI—Soviet Gold Production Since 1930,[a]

Quarterly Production in per Cent of Annual Production

Quarters	1930	1931	1932	1933	1934
First	12.3	10.6	17.2	11.9	12.4
Second	25.8	26.0	28.0	22.5	20.0
Third	43.7	37.6	34.7	38.0	35.4
Fourth	18.2	25.8	20.1	27.6	32.2
	100.0	100.0	100.0	100.0	100.0

[a]The percentage figures for 1930, 1931, and 1932 are quoted from *Sovetskaya Zolotopromyshlennost*, 1933, Nos. 6 and 7, p. 3; those for 1933 and 1934 are calculated from the estimates made in Tables X (revised figures) and XV.

Table XXII—Russia's Gold Production, 1913-1934

Years	Fine Kilograms	Fine Ounces	Value in U. S. Dollars
1913	49,259	1,583,677	55,429,000
1914	53,932	1,733,914	60,687,000
1915	43,000	1,382,450	48,386 000
1916	33,900	1,089,885	38,146,000
1917	27,100	871,265	30,494,000
1918	17,250	554,588	19,411,000
1919	5,400	173,610	6,076,000
1920	2,300	73,945	2,588,000
1921	2,050	65,907	2,307,000
1922	5,950	191,614	6,707,000
1923	9,500	305,425	10,690,000
1924	18,480	594,132	20,795,000
1925	21,565	693,314	24,266,000
1926	27,833	894,831	31,319,000
1927	25,194	809,987	28,350,000
1928	27,965	899 075	31,468,000
1929	33,660	1,085,384	37,988,000
1930	44,593	1,433 665	50,178.000
1931	52,907	1,710,960	59 533,000
1932	61,900	1,990,000	69,650,000
1933	82,958	2,667,100	93,348,000
1934 (preliminary)	132,587	4,262,672	149 194,000

Table XXIII—Production of "Black Sand"

From "The Gold Mining Industry and the New Gold-Bearing Regions in the U. S. S. R.,"

Sources See Footnotes	Year of Publication	1913	1914	1915	1916	1917	1918	1919	1920	1921
						I—"Shlikhovoe Zoloto" (Black Sand); Data				
Item 1	1927	37,486	41,497	41,533	36,781	26,446	11,970	6,129	2,146	2,045
						II—"Shlikhovoe Zoloto" (Black Sand); Data of				
Item 2	1921	60,846	66,439	48,093	30,435	30,885	.....	.....	.....	.....
Item 3	1922	60,838	66,439	48,093	30,451	30,877	20,770	6,536	1,786	1,343
Item 4	1925	60,846	66,447	39,260	33,007(*c*)	17,969(*c*)	.....	.....	.....	4,537
Item 5	1925	61,820	.....	.....	.....	.....	.....	.....	.....	.....
Item 6	1926	60,835	66,437	48,092	30,450	30,876	20,770	6,536	1,786	1,344
Item 7	1926	.....	66,439	48,093	30,451	30,877	20,770	6,536	2,768	2,476
Item 8	1926	60,854	.....	.....	.....	.....	.....	.....	.....	2,473
Item 9	1930-31	.....	.....	.....	.....	.....	.....	.....	.....	.....
Item 10	1931-32	.....	.....	.....	.....	.....	.....	.....	.....	.....
Item 11	1932-33	37,500	.....	.....	.....	.....	.....	.....	.....	.....
						III—Smelted Pure				
Item 12	1925	49,247	63,902	37,748	31,746	30,043	.....	.....	.....	4,364
Item 13	1932	39,800	43,000	39,600	33,900	27,100	20,700	6,200	1,700	1,300
						IV—The Most Likely Data Regarding				
Item 14		37,486	41,497	41,533	36,781	26,446	11,970	6,129	2,146	2,048
Item 15		60,846	66,439	48,093	30,451(*d*)	30,885	20,770	6,536	2,768	2,476
Item 16		23,360	24,942	6,650	.....	4,439	8,800	407	622	428
Item 17		.....	.....	.....	.....	.....	.....	.....	.....	.....
Item 18		.....	.....	.....	.....	.....	.....	.....	.....	.....
Item 19		49,259	53,932	43,000	33,900	27,100	17,250	5,400	2,300	2,050

(*a*) Data for the business year; for example, 1921/22: in the table the corresponding figure is placed in the column for 1922.

(*b*) Approximate data.

(*c*) Presumed output according to plan.

(*d*) The figure 30,451 kg. is obviously much too low. This is borne out by the fact that for this year the Mining Administration shows the output of gold at a considerably higher figure than 30,000 kg.

Item 1. *M. N. Dzhakson and A. N. Flerov.* Collection of Statistical Data Concerning the Mining and Metallurgical Industries of the U.S.S.R. for the Period 1911 to 1924/25. Leningrad, 1928. Pp. 46-47 (in kilograms); the same, for 1925/26. Leningrad, 1928. Pp. 80-160 (in kilograms).

Item. 2. Publications of the Statistical Administration, Vol. VII, Issue 1. Statistical Handbook for the Period 1913/17, Issue 1, Moscow, 1921. P. 80 (in 0.1 poods).

Item 3. The Same, Vol. VIII, Issue 2, Statistical Yearbook for 1918-1920, Issue 2, Moscow, 1922. P. 228 (in poods).

Item 4. *G. F. Tigranov and P. V. Ol.* "Precious Metals." "Wealth of the U.S.S.R.," Issue IV, Moscow, 1925. Pp. 5-6 (in 0.01 poods).

Item 5. *I. V. Buznikov.* "The Present Condition of Our Gold Mining Industry, and Its Outlook." *Vestnik Finansov (Herald of Finance)*, No. 11-12, 1925. P. 185 (in poods).

Item 6. "Mirovoe Khozyaistvo" ("World Economy"): (Statistical Handbook for the Period 1913-1925). Edited by Professor N. D. Kondratev. Moscow, 1926. P. 70 (in kilograms).

Item 7. *I. V. Buznikov.* "The Gold Market of the World." *Vestnik Finansov (Herald of Finance)*, 1926, No. 11. P. 81 (in poods). In the table, the output for 1925 is shown as 1,817 poods; in the text the identical figures are given for the year 1924/25.

Item 8. *Prof. D. A. Lobvetski.* "The Valuta Policy of the U.S.S.R.," Moscow, 1926. P. 57 (in poods).

Item 9. "Annuaire Statistique de la Société des Nations," 1930/31. Pp. 141.

Item 10. "Annuaire Statistique de la Société des Nations," 1931/32. Pp. 160/1.

Item 11. "Annuaire Statistique de la Société des Nations," 1932/33. Pp. 130/1.

Item 12. Same as Item 4. Data for 1916 and 1917—"not claimed to be absolutely correct." Data for 1921 and 1922—only the output of state trusts and combines is shown.

Item 13. "Annuaire de la Statistique Générale de la France pour 1932." P. 336.

Item 14. Black sand according to data of the Mining Administration.

Item 15. Black sand according to data of the gold smelting laboratories.

Item 16. Difference between items 15 and 14.

Item 17. Increase of gold production according to official data.

Item 18. Total output of black sand calculated on increase shown in Item 17.

Item 19. Smelted pure gold.

the plan figures for the various months on this basis. The production plan for January probably amounted to about 5,000 kg. If this is the case, the production program for the first nine months was approximately as shown in Table XII. These figures do not quite check with other information available, but they are close enough to give an idea of the program for 1934, and to support the data given hereinafter concerning the actual production in 1934.

In his recent article in the *Bolshevik*,[10] Serebrovski stated that gold production in the first half of 1934 exceeded that in the corresponding period of the preceding year by 51 per cent, thereby overfulfilling the plan for the first half of the year. It has been shown that the output of gold in the first half of 1933 amounted to 28,509 kg. (Table X) (*cf.* Table II). Adding 51 per cent to this figure, 43,049 kg. is obtained, being the amount of gold produced in the first half of 1934. This checks very well with the approximate plan figures in Table XII, according to which the plan for the first half of the year amounted to about 42,850 kg. Serebrovski's statement that the plan was overfulfilled is confirmed by the figure calculated.

The output of gold in the first quarter of 1934 exceeded that of the first quarter of 1933 by 67.3 per cent.[12] Adding 67.3 per cent to 9,864 kg. (Table X), the result is 16,502 kg. for the first quarter of 1934, and, deducting this figure from 43,049 kg., the quantity produced in the first half of the year, it is found that 26,547 kg. was produced in the second quarter. The first half of 1934 therefore appears as in Table XIII.

In July, 1934, the output of gold was 49.5 per cent larger than in the corresponding month of the preceding year; in August it exceeded 1933 production in the same month by 40 per cent.[13] Figures for these two months in 1933 were 9,480 and 10,587 kg. (Table X, revised estimates). Production in 1934 may therefore be estimated at 14,172 kg. in July and 14,821 kg. in August. Adding these two figures to the quantity of gold produced in the first half of the year, one gets 72,042 kg. of gold produced in the course of the first eight months of 1934. This was confirmed by the Soviet press, which stated that the gold production increased during the first eight months of the year by 49.4 per cent,[14] which is close to the figure presented in a preceding statement (1933 production in eight months = 48,576 kg., plus 49.4 per cent).

No percentage figure is given indicating the increase of production in September. It is reported, however, that there was an increase of 50 per cent in the first nine months over the same period of 1933.[15] According to the revised estimates, 59,982 kg. of gold was produced in the first three quarters of 1933. Adding 50 per cent to this gives 89,973 kg. for the same period of 1934. This means that 17,931 kg. of gold was produced in September,[16] and the total production in the course of the first three quarters appears as in Table XIV.

Za Industrializatsiyu stated[15] that the plan for the first nine months had been overfulfilled. The estimate made in Table XII gave 87,800 kg. as the planned output in the first nine months. The actual output was therefore about 2,000 kg. larger than estimated.

No percentage figure has been found in the Soviet press for October. It has been reported, however, that 108,000 kg. was produced during the first nine months,[17] which would mean that 18,027 kg. was produced in October.[18] This figure is close to that for September and is not improbable.

On Dec. 1, 1934, the gold industry had fulfilled its entire annual production program, with 49 per cent more than the production for the entire preceding year. This is what Serebrovski

and Smelted Pure Gold in the U.S.S.R.

Published in Bull. No. 116, Oct., 1934, of the Economic Cabinet of Prof. S. N. Prokopovich, of Prague

1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
of the Mining Administration, in Kilograms											
5,367(*a*)	9,215(*a*)	16,586(*a*)	19,270(*a*)	24,931(*a*)	.....	.....	.....	.....	.....	.....	.....
the Gold-Smelting Laboratories, in Kilograms											
....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5,143	7,600(*c*)				.....	.....	.....	.....	.....	.....	.....
5,438(*a*)	11,466(*a*)	21,295(*a*)	27,847(*a*)	36,000(*c*)	.....	.....	.....	.....	.....	.....	.....
5,300	10,400	10,900			.....	.....	.....	.....	.....	.....	.....
7,191	11,466	23,997	29,763	33,007(*c*)	.....	.....	.....	.....	.....	.....	.....
.....	11,466(*a*)	23,916(*a*)	29,763(*a*)	.....	.....	.....	.....	.....	.....	.....	.....
4,270	9,884	16,586	19,270	24,930	22,553	.....	.....	27,000	.....	.....	.....
5,773	11,179	20,000	25,258	25,149	22,600	28,830	33,300	44,000	52,000	.....	.....
5,773	11,179	20,000	25,258	25,149	18-22,500	28,830	24-26,000	27-32,000	32-36,000	38,000	.....
Gold, in Kilograms											
4,997	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4,600	7,800	29,800	30,600	30,900	33,000	37,300	31,100	44,600	52,900(*b*)	.....	.....
Production of Black Sand and Pure Gold											
5,367(*a*)	9,215(*a*)	16,586(*a*)	19,270(*a*)	24,931(*a*)	.....	.....	.....	.....	.....	.....	.....
7,191	11,466(*a*)	23,997(*a*)	29,763(*a*)	32,000(*a*)	.....	.....	.....	.....	.....	.....	.....
1,824	3,251(*a*)	9,411(*a*)	10,493(*a*)	7,069(*a*)	.....	.....	.....	.....	.....	.....	.....
....	.....	.....	.....	.....	100%	111%	134%	177%	209%	248%	350.9%
.....	.....	.....	.....	.....	30,000	33,300	40,000	53,100	62,700	74,500	105,300
	,500(*a*)	19,920(*a*)	24,700(*a*)	26,600(*a*)	24,900	27,600	33,400	44,100	52,000	61,800	87,400

stated recently in the *Bolshevik*.[19] According to this statement, the industry produced in eleven months of 1934 about 123,587 kg. of gold (1933 output 82,958 kg., plus 49 per cent), which amount almost coincides with the revised plan figure previously mentioned in this memorandum (p. 275). Thus there was produced 15,587 kg. of gold in the month of November.[20]

No figures are yet available for the month of December. The December production will probably be much smaller than the exceptionally high production in the preceding months. If the December output is estimated at about 9,000 kg., the figures in Table XV showing the Russian gold production in 1934 are obtained.

According to this preliminary estimate, the Russian gold production in 1934 amounted to at least 132,587 kg., an increase of almost 60 per cent compared with the output in 1933. If the December production exceeded 9,000 kg., the total output of gold would naturally be still larger. Expressed in ounces, the Russian gold production amounted to 4,262,672 oz., to a total value of $149,194,000, or roughly $150,000,000.[4]

Table XVI shows the trend of Soviet gold production during the last few years, based on the latest available information and the revised estimate for 1933 as given heretofore. Ounces and dollars are calculated as already indicated.[4]

An article in *Sovetskaya Zolo-*

The black dots in the map presented below designate the locations of some of the recently discovered gold deposits, placer as well as lode, together with other important gold mines in the Soviet Union

topromyshlennost,[21] furnishes percentage figures, on the basis of which it is possible to calculate the production of gold in the various quarters of the years 1930 to 1932, as shown in Table XVII. These figures, together with those given in Tables X (revised estimates) and XV, for the years 1933 and 1934, permit the compilation of Table XVIII, showing Soviet gold production since 1930, by quarters. The tabulation gives an interesting illustration of the trend of development of the Soviet gold industry.

It will be seen that the spelndid result obtained in 1934 was due to a large extent to the extension of the summer operations well into the fall. The excellent output in the fourth quarter of the year is largely responsible for the large increase in production. *Sovetskaya Zolotopromyshlennost*[22] confirms this, and credits it to Ordzhonikidze, People's Commissar for Heavy Industry of the U.S.S.R., since it was he who issued the order concerning the extension of the gold production season (Order of Aug. 23, 1933).[23] The percentage figures in Table XXI, giving quarterly production in per cent of annual production, better illustrate this fact. This table shows the increasing share of the fourth quarter in the annual gold production, with the result that 1934 was much more satisfactory than preceding years, when the output ordinarily began to drop early in the fall.

The second cause of the marked increase was the rapid expansion of production in the Urals. The Soviet press reported[24] that in the first nine months of 1934 the Ural output had trebled in comparison with the corresponding period of 1933. There is also no doubt that newly discovered gold districts have played an important part in the rapid increase. Brief descriptions of these gold districts, as well as some other interesting details, are to be found in a careful study on the "Gold Mining Industry and the New Gold-Bearing Regions in the U.S.S.R.," by Prof. S. N. Prokopovich, of Prague.[24] The article includes Table XXIII, reproduced herewith, giving a compilation of figures from various sources. As was shown in Table II, Prokopovich's figures for the production of pure gold (Item 19 in Table XXIII) since 1927 are very near to those accepted in this memorandum, except for 1933, which had to be revised on the basis of Serebrovski's latest percentage figures.

In his article[24] Prokopovich mentions the third cause of the rapid expansion of gold production: the progressing mechanization of the gold-mining operations. This was confirmed recently by Serebrovski in an article in the *Bolshevik*,[25] in which he stated that whereas before the War, in 1913, only 20 per cent of the total output of gold was mechanically produced, and in 1926, 25 per cent, as much as 70 per cent of the total output was so produced in 1933.

The production of reef gold has also increased. Whereas before the War, reef gold represented only 13 per cent of the total output, in the last few years it has increased as shown in Table XIX.[26]

It is expected that the percentage of reef gold will further increase.

The large increase in the number of laborers occupied in the gold industry, mentioned by Prokopovich, has also contributed to the marked improvement in gold production.

In his study Professor Prokopovich throws light on a much-disputed fact, the pre-War gold production of Russia. The actual Russian gold production in 1913 has never been known. Available sources of information give many different figures, varying between 37,500 and 60,846 kg. (Table XXIII). It was thought that 37,500 kg. represented only "registered gold"—that is, gold registered at the Mining Department—and that it did not include non-registered gold and gold recovered in the process of refining non-ferrous metals, and it was believed that the 60,846 kg. included *all* gold produced in 1913. According to Prokopovich, the latter figure does not represent chemically pure gold, but only so-called "shlikhovoe zoloto," or "black sand."[27] Prokopovich bases his statement on a very well-informed source, the volume *Dragotsennye Metally*[28] *(Precious Metals)*, by C. F. Tigranov and P. V. Ol (Moscow, 1925, State Publishing Office), which supplies the data given in Table XX. This explanation is thought to be correct, since the source on which Prokopovich bases his statement is a very reliable and well-informed one.

In Table XXIII Prokopovich is mistaken in the quantities for the years 1914 to 1922, quoted from *Dragotsennye Metally* (Tigranov and Ol.), under "pure gold." This source gives the respective figures quite correctly as "shlikhovoe zoloto," and it is necessary to make a certain reduction in order to obtain pure gold. Prokopovich has actually done this in his table, and he arrives (Item 19) at net figures which may be accepted as the most accurate available for Russian gold production up to 1923. The figures shown for the years 1924 to 1926 in Table XXII, giving a general review of the Russian gold production since 1913, have been calculated from various Soviet sources, those for the last few years from figures given in this article. Ounces and dollars are calculated as already indicated.[4]

The Russian output of gold in 1934 is almost 2½ times larger than the output in 1914, Russia's greatest pre-War production year.

The world gold production in 1915 amounted to 22,594,000 oz.; in 1933, to 24,720,000 oz.[29] Whereas Russian gold production in 1915 was only 6.1 per cent of the world production, in 1933 it was 10.8 per cent. In 1934 it reached about 16 to 17 per cent of the world production.

The gold production of the United States in 1933 amounted to 2,537,000 oz.; Canada, 2,938,000 oz.[30] According to a preliminary estimate the output of gold in the United States in 1934 amounted to about 2,970,000 oz.; whereas Canadian production has apparently remained on the level of the preceding year.[31] A comparison of these figures with the Soviet gold production will show that the production in 1934 by far exceeded the production in each of these countries.

[Editor's Note: World gold production in 1915, according to the United States Mint, was 23,010,348 oz., and H. N. Lawrie estimates (May, 1935) that 25,150,133 oz. was produced in 1933 and 27,474,516 oz. in 1934. The latest data for the gold production of Canada are 2,949,309 oz. in 1933 and 2,964,395 oz. in 1934; in the United States (including the Philippines) the data are 2,556,246 oz. in 1933 and 3,075,192 oz. in 1934.]

Serebrovski recently[32] repeated the statement made a year ago that in a few years Soviet gold production would exceed the production of the Transvaal and would then occupy first place among the gold-producing countries of the world, which fact, in view of the rapid development of the Soviet gold industry in the last few years, would not appear improbable.

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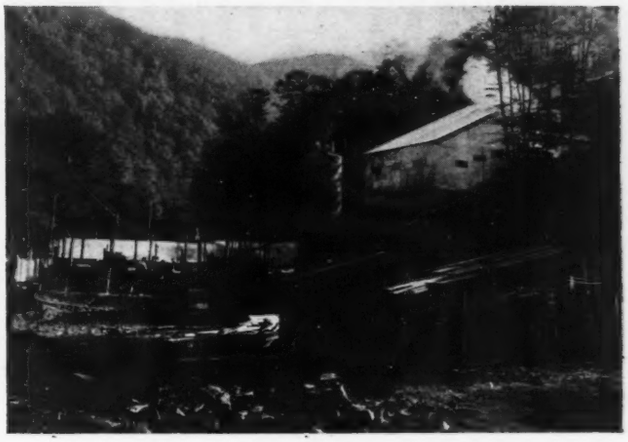
[1]Moscow *Izvestiya*, No. 4, Jan. 4, 1934, p. 2.
[2]*Sovetskaya Zolotopromyshlennost*, 1934, No. 5, June-July, p. 7.
[3]*Sovetskaya Zolotopromyshlennost (The Soviet Gold-Mining Industry)* Moscow, 1934, No. 1, p. 5.
[4]Calculated at 32.15 fine ounces to the kilogram and based on the new gold valuation, $35 per ounce.
[5]*Der Ost-Express*, Artikeldienst (Article Service), Berlin, 1934, No. 19 (757).
[6]*Sovetskaya Zolotopromyshlennost*, 1934, No. 8, October, p. 7.
[7]1933, Nos. 6 and 7, p. 3.
[8]No. 8, Oct. 1933, p. 1.
[9]*Sovetskaya Zolotopromyshlennost*, 1933, No. 6-7, p. 3.
[10]*Bolshevik*, Political-economic fortnightly magazine of the Central Committee of the All-Union Communist Party (of Bolsheviks), No. 24, Dec. 1934, p. 38.
[11]No. 8, Oct. 1934, p. 7.
[12]Moscow *Za Industrializatsiyu*, No. 86, April 11, 1934, p. 4.
[13]Moscow *Izvestiya*, No. 181, Aug. 5, 1934.
[14]Moscow *Za Industrializatsiyu*, No. 212, Sept. 11, 1934.
[15]*Ibid.* No. 238, Oct. 12, 1934.
[16]89,973 kg. minus 72,042 kg. produced in July and August.
[17]*Rigasche Rundschau*, Riga, Dec. 31, 1934.
[18]108,000 kg. minus 89,973 kg. produced in nine months.
[19]No. 24, Dec. 31, 1934, p. 46.
[20]123,587 kg. minus 108,000 kg. produced in ten months.
[21]1933, Nos. 6 and 7, p. 3.
[22]1934, No. 8, p. 8.
[23]Moscow *Za Industrializatsiyu*, No. 243, Oct. 18, 1934, p. 2.
[24]Bull. No. 116, Oct. 1934, of the Economic Cabinet of Prof. S. N. Prokopovich, of Prague.
[25]No. 24, Dec. 31, 1934, p. 42.
[26]*Bolshevik*, No. 24, Dec. 31, 1934, p. 43.
[27]"Godovoi Osbor Mineralnykh Resursov S.S.S.R. Za 1926-27 God" ("Annual Report on the Mineral Resources of the U.S.S.R. for 1926-27"), Leningrad, 1928, Edition of the Geological Committee, Vol. II, p. 367.
[28]*Dragotsennye Metally, (Precious Metals)*, p. 5, kilograms calculated at the rate of 61 poods equal 1,000 kg.
[29]*Vneshnyaya Torgovlya (Foreign Trade)*, Moscow, Organ of the People's Commissariat for Foreign Trade of the U.S.S.R., 1934, No. 16, p. 15.
[30]*Ibid.*, 1934, No. 16, p. 15.
[31]*New York Herald* (Paris edition), Jan. 14, 1935.
[32]*Sovetskaya Zolotopromyshlennost*, 1934, No. 5, p. 7.

The Gold Mine of St. Barbara

A Property Placed on a Profitable Basis in Six Months

Administrative camp at the gold mine of St. Barbara, looking up the Pek River. The occurrence of gold in the gravels of this stream was known to the ancient Romans, and later the Saxons are believed to have worked the mother veins



Mill building after being enlarged to 80-ton capacity. Immediately below it is the chimney for the new power house, foundations of which may be seen in the lower left. A plant for cyaniding the mill tailings is to be erected this summer

John L. Middleton

Director, Rudnik Sveta Varvara, Posta Kucevo Pozarevacko, Yugoslavia

◆

An 80-ton amalgamation plant, now functioning, is to be supplemented by a mill for cyaniding the tailings. Over-all recovery is expected to be in the neighborhood of 90 per cent. Present production is at the rate of 20 kg. of gold per month

OCCURRENCE of gold in the gravel of the Pek River, in old Serbia, was known as long ago as the Roman occupation of the province. The Romans worked the gravel terraces of the alluvial and saprolitic deposits which were to be found above the water level. Later, the Saxons worked in the region, probably mining the enriched outcrops of the veins, and also in surrounding regions, doing underground work for lead and copper.

Along one side of this river, in the Homolje region, in the Commune of Voluja, is the concession of St. Barbara, about 25 miles from the Danube as the crow flies. This is in the eastern part of the country, about 112 miles from Belgrade by auto, the nearest shipping point being at Vel. Gradiste, on the banks of the Danube about 45 miles from the mine. A railroad now being built will reach a point only 20 miles away. The concession includes 46 mining permits covering a total area of 2,000 acres.

Felix Hoffmann, a Serbian mining engineer, started underground work in one of the veins of St. Barbara about 1890. Having blocked out a certain amount of ore, he was forced to abandon work in 1912 by the invasion of the Bulgarians.

The present operating company commenced work at the mine on June 15, 1933, and started producing at a profit at the rate of about 12 kilos of gold per month by Dec. 1, 1933. During these five and a half months over a mile of caved underground workings were reopened and timbered, a 40-ton amalgamation plant was bought and erected, and modern houses were constructed for the staff.

The country rock to be found within the limits of the concession of St. Barbara is a metamorphosed series of sediments and igneous rocks, including mica shists, chlorite schists, biotite schists, calcareous schists, and gneisses of varying acidity, ranging from granite gneiss to gabbro gneiss. All of these rocks have been intensely folded and faulted. Just outside the western border of the concession is a granite batholith. To the northeast of the limit of the concession is a similar batholith, but with less quartz as an original component of the rock. Both of these large masses of acid rock, which seem to be much younger than the metamorphosed schists and gneisses of the region, carry more than traces of gold and are probably the parent rock of the gold-bearing veins.

The quartz veins in which the paying values of gold are found seem to follow in general a direction north 20 deg. east-south 20 deg. west. However, branches of the main lenses and of lens-shaped veins may be at any angle to this general direction. The richer ore seems to lie in the upper parts of the vein. As a rule, values diminish with depth, but insufficient work at depth has been done to eliminate the possibility of paying ore-shoots continuing at a greater depth than now known. Indications of secondary enrichment are plentiful.

The vein material is about 90 per cent quartz, carrying from 1 to 8 per cent sulphides, of which pyrite is predominant. Smaller quantities of galena, blende, chalcopyrite, kaolin, and native gold are present in the ore. Iron oxides, resulting from the oxidization of pyrite, are also present.

Values of gold in the vein vary greatly over small distances, and in the same vein of apparently uniform appearance in a distance of 5 meters one may obtain ore that assays across the complete width of the vein from 1 to 100 grams per ton. However, without "high-grading" the mine the company has readily kept mill heads at about 15 grams per ton, using ore that is being extracted in exploration work. Although one can generally pick up a specimen of mineral on the ore dump that shows visible free gold, such specimens are exceptional, and the run-of-the-vein shows little gold visible to the naked eye.

Although all of the metamorphosed

crytalline schists and gneisses are folded and faulted, two zones exist, one about 100 meters wide and the other about 50 meters wide, in which faulting and fracture has been greater. Mineralization seems to favor these zones, which are discovered by surface trenching, accompanied by frequent use of the gold pan in the decomposed rock. Dry ravines which cut this zone are panned and values noted. Eventually, if the decomposed rock, which is generally reddish clay, gives sufficiently high values, the trenches are deepened in these places, and, if indications continue favorable, an adit or a shaft is sunk to prove the values at depth. During the summer prospection two new veins were thus discovered.

Practically none of the veins outcrop. Two or three meters of earth and talus cover all the rocks in the region. One vein was recently discovered by following up quartz float.

So far, the paying veins have been found at an altitude of 80 meters or more above the level of the Pek River. As the country is mountainous, the ore is opened up in the main part by adits rather than by shafts. When a vein is intercepted, it is followed horizontally by drifting; then raises are put up at intervals of about 25 meters.

The greatly varying widths and dips of the veins necessitate the use of many methods of mining. Hand drilling is used in place of machine drilling. This method, although slow, is found to be cheaper than using air drills. All headings in quartz are sampled once a day. The ore is transported from the dumps of the various levels by ox carts that carry 1.1 kilos per cart. From the carts the ore is dumped into a large open reservoir above the mill, and is then trammed to the mill by hand.

The ore first passes over a 1½-in. grizzly, the oversize going to a Blake jaw crusher, the undersize directly to the mill bins. From the bins it is fed into the stamps by Nelson feeders. Stamp discharge is 20 mesh. After passing over the first mercury tables, it goes to a spitzkasten that discharges the sands into a ball mill for further grinding previous to passing over a second set of mercury tables. From these tables it passes over tables covered with Linatex blankets, and from the tables the waste material is sent to the tailing dump.

Of the total gold recovered, about 60 per cent is won by inside amalgamation and splash plates, 20 per cent on the first tables, 15 per cent on the second tables, and 5 per cent on the blanket tables. Total recovery is about 75 per cent, but it may vary from 65 to 85 per cent.

The mill described treated 40 tons per day. Its capacity has been doubled, the enlarged plant having been producing since March 1 this year. A cyanide plant to treat the tailing will be installed next summer. Tests have shown that extraction may readily be increased to 90 per cent by amalgamation and cyaniding.

In twelve months the St. Barbara has produced and delivered to the National Bank of Yugoslavia 148 kg. of gold. The management hopes to be producing 20 kg. of the metal per month from now on.

I wish to thank the Compagnie Française des Mines d'Or du Pek, headquarters at Rue du Bac 43, Paris, for permitting me to publish the information and the data that are presented in this article.

Determining Cyanide and Sulphocyanate in Small Amounts

As in Tailings Pond Overflow and Seepage

E. C. Boyman
Chemist, Melones, Calif.

ONE PART of sodium cyanide can be detected in 50 million parts of water by the method to be described, hence its applicability to determine the amount of sodium cyanide and sodium sulphocyanate present in cyanide plant tailing pond overflow and seepage waters. Although silver, copper, cobalt, and mercuric chloride interfere, it can be used in the presence of the many ordinary metals and of organic matter. The method is based on the fact that ferric iron and an alkali sulphocyanate, ammonium, or potassium sulphocyanates in an acid solution give a red color, the intensity of which is proportional to the quantity of sulphocyanate present. The color is due to the formation of the compound $Fe(CNS)_3 .9KCNS.4H_2O$. If sulphocyanates are present, they are determined and subtracted from the first titration, which is calculated to sodium sulphocyanate. The difference is calculated to sodium cyanide.

Reagents required are as follows: A sodium sulphocyanate solution containing 1 gram of sodium sulphocyanate to 1 liter of water, so that 1 c.c. of this solution is equivalent to 1 mg. of sodium sulphocyanate; ammonium polysulphide solution, which is prepared by saturating 600 c.c. of ammonium hydroxide with hydrogen sulphide and then diluting to 1,000 c.c. with ammonium hydroxide, and to which is added from 50 to 75 grams of powdered sulphur, it then being shaken until the sulphur is in solution; a saturated solution of ferric iron aium, a 10 per cent solution of sodium hydroxide, and a 10 per cent solution of sulphuric acid (by volume).

The method is relatively simple. The solution is filtered and from 100 to 1,000 c.c. is taken for the determination. Add 1 c.c. of 10 per cent sodium hydroxide and ½ c.c. of ammonium polysulphide to the solution in a large porcelain evaporating dish and evaporate just to dryness. Next add 25 c.c. of water to the evaporated solution and 10 c.c. of 10 per cent sulphuric acid. Transfer the solution to a 100-c.c. beaker and boil gently for fifteen minutes, to boil off any sulphur dioxide and to coagulate the sulphur. Cool the solution to room temperature and then filter on a 9-cm. filter paper, using a copious amount of paper pulp. Refilter if the solution comes through the filter cloudy. Transfer the solution to a 100-c.c. Nessler tube and add 5 c.c. of ferric iron alum and make up to 100 c.c. with water and mix thoroughly. In another Nessler tube add 10 c.c. of 10 per cent sulphuric acid and 5 c.c. of ferric iron alum.

Now add the sodium sulphocyanate solution from a burette to the second Nessler tube and match the color and volume of the first Nessler tube. If sulphocyanates are present in the water they must be determined. This is done by evaporating 100 to 1,000 c.c. of the sample with 1 c.c. of 10 per cent sodium hydroxide just to dryness, then taking up the residue with 25 c.c. of water and 10 c.c. of 10 per cent sulphuric acid, filtering, and determining by colometric means as in the preceding. The number of cubic centimeters multiplied by 0.001 gram, multiplied by 100 and divided by the number of cubic centimeters taken, gives the percentage of sulphocyanates in the sample.

If both sodium cyanide and sodium sulphocyanates are present, calculate the first titration to sodium sulphocyanate and subtract the second titration and calculate the difference to sodium cyanide. The factor for converting sodium sulphocyanate to the latter is 0.6042.

Preparing Ore By Explosive Shattering

R. S. Dean
Chief Engineer, Metallurgical Division

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Metallurgist

Carl E. Wood
Assistant Chemist

United States Bureau of Mines
Washington, D. C.

Advantages Claimed

Compared with fine grinding, include:

Lower Costs for Power and Upkeep

A Dry Product

A Lessened Amount of Slime And Decreased Tailings Losses On Leaching

Also the Possibility of Separating Component Minerals by Differential Breaking

SEVERAL YEARS AGO discovery was made that if an explosion wave be set up on the surface of mineral particles they would be effectively shattered. Experiments were performed in which the wave was obtained by the explosion of a coating of an explosive substance on the ore particle, but it was soon found that a film of superheated water was more satisfactory.[1]

In its present form the process consists in the formation of a water film on the surface of the ore by condensation from steam at pressures up to 250 lb. or more and in the sudden release of the pressure to explode the water film. The mechanism of the shattering process has not been determined, but evidently some action other than impact of the particles against one another or against the chamber is involved. The extensive experiments made indicate that the shattering is probably done by an explosion wave breaking down the ore preferentially along planes of low fatigue strength. These planes may be boundaries between different kinds of minerals, or planes of secondary structure built up during crystallization of the mineral. This conception is important, because it means that explosive shattering is especially adapted to differential grinding[2] and to the preparation of ores for leaching,[3] where the valuable mineral, such as gold in pyrite, is deposited along the planes of secondary structure of the minerals.

Inasmuch as the energy of the steam is applied directly to the ore particles, explosive shattering is obviously more economical than any grinding operation where the energy of the steam must undergo loss through the engine, the generator, and the transmission system.

Apparatus Developed in Laboratory

The apparatus used has gone through a long development stage in the laboratory. We believe that the principles embodied in the final laboratory machine may be applied without radical change to commercial equipment.[4] The photograph here reproduced is a view of the laboratory apparatus in its present development, and the accompanying sketch shows our concept of a commercial machine based on satisfactory continuous operation of the laboratory unit having a capacity of 500 grams.

The cycle of operation includes the following steps: 1, Charging. 2, Charge valve closed. 3, Steam turned on. 4, Steam turned off. 5, Discharge valve opened, explosion taking place. 6, Discharge valve closed. 7, Charge valve opened.

Essentially, the machine consists of an explosive chamber having a feed inlet capable of being tightly closed, a steam inlet, and a discharge valve which can be opened quickly and tightly closed.

The feed inlet in the laboratory machine is a quick-opening valve through which the feed is introduced by means of a funnel which discharges its load after it has passed through the valve so as to keep grit out of the valve seat. The feed device, shown in the drawing, which is similar to the discharge valve, will avoid the extra manipulation of the feed funnel.

A hardened-steel cone seating against a lead ring constitutes the discharge valve. The lead seat does not have a long life, but it can be replaced easily and inexpensively. Possibly, in a commercial machine it may be built up by casting the ring in place. The life of the seat may probably be lengthened by using a harder alloy or metal than lead.

Material delivered from the explosion chamber is dry, so that a trommel or shaking screen will probably be best for removing the finished product.

Time of steaming and pressure varies with the ore, but our experience indicates that two seconds of steaming at 250 lb. generally gives good results. With such a short steaming period, eight explosions per minute would give ample time for the loading and other necessary operations. On this basis a 100-lb. unit could handle 24 tons per hour. Tests have indicated that the circulating load is 75 to 80 per cent for hard dolomite, crushed to 48 mesh, so that the estimated capacity of such a unit would be 5 tons per hour of finished product, and the five-unit machine, shown in the line drawing, would

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[1]Dean, R. S., and Gross, John: "Explosive Shattering of Minerals as a Substitute for Crushing Preparatory to Ore Dressing." Report of Investigation, 3118, U. S. Bureau of Mines, February, 1932.

[2]Dean, R. S., and Gross, John: "Explosive Shattering of Minerals." Report of Investigation 3201, U. S. Bureau of Mines, February, 1933.

[3]Gross, John: "Progress in Explosive Shattering of Minerals" Report of Investigation 3223, U. S. Bureau of Mines, Progress Reports-Metallurgical Division, Mineral Physics Studies, February, 1934.

[4]See Footnote 3.

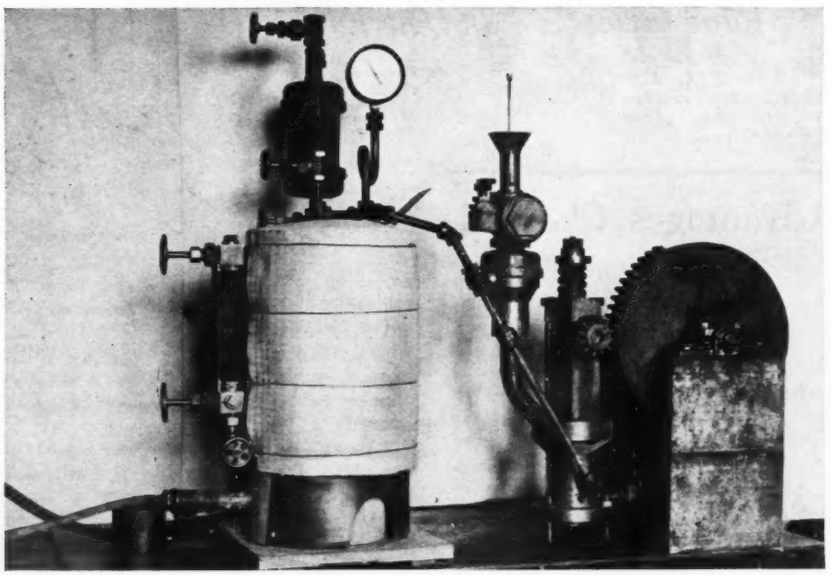
Table I—Capacity for Different Materials With One 100-Lb. Explosive Unit

Material	—48 Mesh From Each Explosion, per Cent	Capacity per Hour One 100-Lb. Unit, Tons
Chert or quartz	10	2.4
Dolomite	20	4.8
Amygdaloid copper ore	12	2.9
Scheelite ore	22	5.3
Hematite ore	24	5.8
Coal	40	9.6

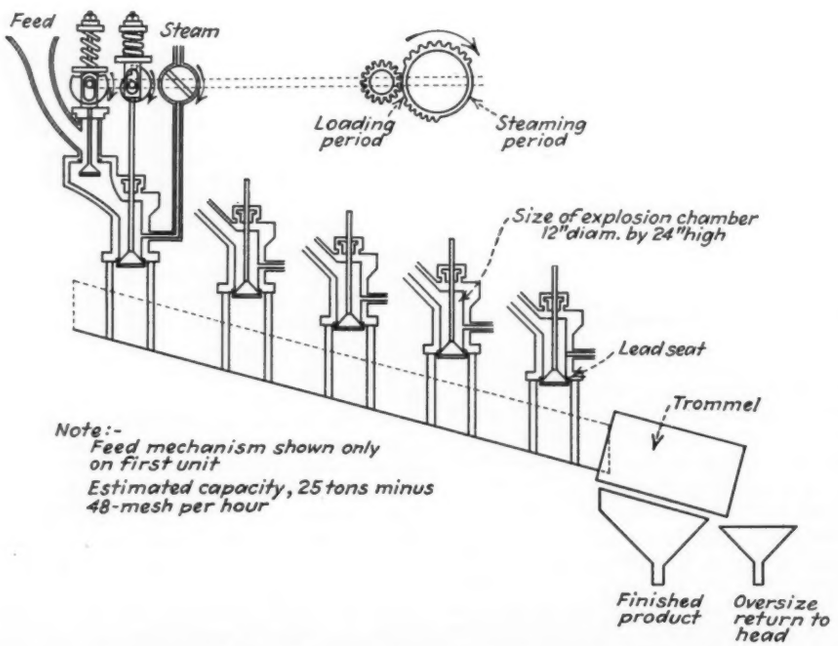
Table II—Steaming Cost of Explosive Shattering

Steaming Time, 2 Sec.; Size of Original Feed, 3 Mesh; Circulating Load, 80 Per Cent

Finished Product, Through	Cents per Ton of Finished Product: 150-Lb. Pressure, 200-Gram Charge	150-Lb. Pressure, 400-Gram Charge	250-Lb. Pressure, 200-Gram Charge	250-Lb. Pressure, 400-Gram Charge	Estimated for 100-Lb. Charge
14 mesh	3.4	2.7	4.2	3.1	0.9
48 mesh	5.6	4.7	6.7	5.1	1.6
100 mesh	8.5	7.3	9.6	7.4	2.5
200 mesh	12.6	10.9	14.4	11.0	3.8
Steam condensed per ton of charge, lb.	42.0	28.0	87.0	54.0	20.0



Laboratory view of the machine developed by the United States Bureau of Mines for shattering minerals by explosion



A proposed layout for preparing ore by the explosion method. The feed mechanism is shown only on the first unit. Capacity is estimated at 25 tons of minus-48-mesh material per hour

Table III—Explosive Shattering of a Lead-Zinc Ore

0.70 Per Cent Lead, 3.63 Per Cent Zinc; Feed, ¼- to ⅝-In. Size; Exploded at 100-Lb. Pressure

Explosion	Minus 48 Mesh Produced, Cumulative per Cent	Recovery in Minus 48 Mesh, per Cent: Lead	Zinc
1	2.3	1.1	15.7
2	5.6	32.2	34.9
3	9.1	68.5	52.3
4	12.3	82.7	66.2
5	15.3	88.2	75.1
6	18.0	90.2	83.1
7	20.1	91.1	87.9
8	22.6	91.9	91.8
9	24.3	93.0	94.2
10	26.0	94.7	96.5
11	27.7	97.2	97.5
12	29.1	100.0	97.5

Table IV—Explosive Shattering of Kyanite-Biotite Ore

Feed, ¼ to ¾-In. Size; Exploded at 200-Lb. Pressure

Explosion	Mesh	Weight, per Cent	Analysis Kyanite, per Cent	Contained Kyanite, per Cent
1	+8	75.9	41.8	97.4
	—8	24.1	3.4	2.6
2	+8	47.9	61.1	89.9
	—8	52.1	6.3	10.1
3	+8	33.8	49.8	76.3
	—8	66.2	11.8	23.7
4	+8	24.6	80.8	61.0
	—8	75.4	16.8	39.0
5	+8	15.9	86.5	42.3
	—8	84.1	22.3	57.7

Table V—Results of Cyanidation Tests on Auriferous Pyrite After Explosive Shattering

Treatment	Plus 400 Mesh, per Cent	Au Extraction, per Cent
Two explosions followed by cyanidation	2.7	80.9
Fine grinding in cyanide solution followed by cyanidation	0.1	67.3
Ball-mill grinding followed by cyanidation	2.3	56.3
No preliminary treatment	7.5	48.2

Table VI—Table Concentration of Scheelite Ore Prepared by Ball Milling and by Explosive Shattering

	Weight, per Cent	Analysis WO_3 per Cent	Contents WO_3
Ball milling:			
Concentrate	4.54	25.23	72.3
Tailing	95.46	0.46	27.7
Explosive shattering at 250-lb. pressure:			
Concentrate	7.27	23.13	87.5
Tailing	92.73	0.26	12.5

have a capacity as high as 25 tons per hour.

The ease of shattering the ore, of course, affects the circulating load, and, hence, the capacity. Table I gives the percentage crushed through 48 mesh and the capacity per hour of a single 100-lb. unit for each explosion after reaching a steady state.

For the purpose of determining cost by explosive shattering a dolomite ore was selected. The cost of coal of 10,000 B.t.u. was taken as $2 per ton and the boiler efficiency at 90 per cent. The results of tests under the best conditions of time of steaming and pressure are given in Table II.

The cost of grinding similar material through 48 mesh by ball milling in a large Southeast Missouri mill is given as 10c. per ton. The steaming cost in a 400-gram unit is, therefore, only about one-half of this ball-milling cost.

Preferential Shattering—The preferential shattering of metallic minerals in explosive preparation and their concentration in the finer sizes is well illustrated on lead-zinc ores. Results on a typical ore are given in Table III.

From these results one can see that all of the lead and 97.5 per cent of the zinc were obtained in less than 30 per cent of the original ore by separating the minus-48 mesh in the exploded product.

In another experiment a kyanite-biotite ore,[5] consisting of intimately intergrown pieces ¼ to ¾ in. in size, was used for explosive shattering. Preliminary tests indicated that practically free particles of the two minerals could be obtained at 8-mesh size.

The kyanite resisted shattering to a much greater extent than the biotite, resulting in a tendency for the former to become freed. The results in which a kyanite was increased from 41.8 to 86.5 per cent purity, in the coarser size, with five explosions, are given in Table IV on the preceding page.

From these results explosive shattering appears to have considerable promise for the production of high-grade kyanite and biotite from ores of this nature. No attempt was made to separate the kyanite in the minus-8-mesh size.

Preparation for Leaching—The remarkable effect of the process in decreasing the loss in cyanide tailings in the treatment of gold ores is well illustrated in the following typical example. The ore was an auriferous pyrite concentrate, and the results in Table V show the gold extractions by cyanide after different crushing treatments.

In another test the cyanide extraction was increased from 30.0 per cent by ball milling to 80.0 per cent by one explosion.

Reduction of Slimes—In the preparation of iron ores for treatment, the explosion method has important advantages.[6] In ball milling, minus-48-mesh iron ores yield 7 to 30 per cent true slime. The explosive shattering method yields less than 0.5 per cent on the same ore. The advantage of the explosion process in treating an easily slimed tungsten ore is shown in Table VI.

Advantages of Explosive Shattering

1. Low power cost. The estimated steaming cost of 1.6c. per ton of hard ore ground to minus 48 mesh is less than one-fifth of the power cost with ball mills.

2. Low upkeep. The valve wear will be considerably less than ball and liner wear.

3. A dry product. Where dry methods of treatment, such as magnetic, electrostatic, and air separation are to be employed, or the product is to be used directly in smelting, the cost of drying is obviated.

4. Differential shattering. A marked separation of the components of the ore may be made by simple screening.

5. Improved amenability to leaching. In gold ores requiring fine grinding for the recovery of the gold by cyanidation, explosive shattering materially decreases tailing losses.

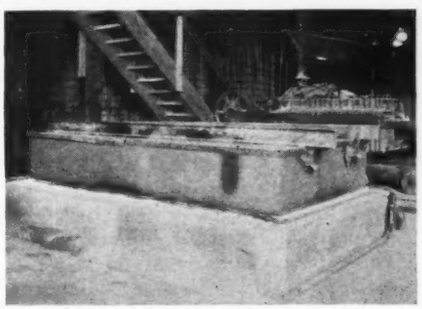
6. Reduction in amount of slimes. Less slime is produced in explosive shattering than in any other fine-grinding methods.

[5]See Footnote 2.

[6]Gross, John: "Explosive Shattering of Iron Ores." Report of Investigations 3229, U. S. Bureau of Mines Progress Reports, Metallurgical Division, Studies in Direct Production of Iron and Steel From Ore, May, 1934, pp. 33-35.

Precipitate Dryer Heated Electrically

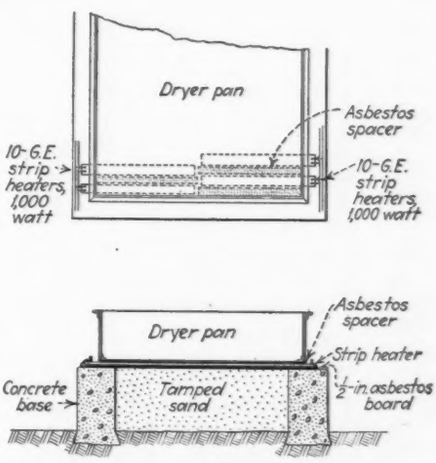
ECONOMIC DRYING of precipitates by electricity is an accomplishment long desired by millmen. Many small-size dryers have been perfected in recent years, but development of an electric dryer of large capacity to replace the wood- or oil-fired apparatus employed at the average mill has lagged because of lack of a dependable heating element and other mechanical difficulties. The dryer illustrated herewith, developed by Albert Silver, consulting engineer, Tonopah, Nev., and installed at the new plant of General Metals Recovery Corporation, at Millers, Nev., meets all requirements as to low power consumption and safety in operation and has proved more satisfactory than the wood-fired apparatus formerly used. Operation is continuous, and no attendant is required.



Electric heat supplied by 20 strip elements is used effectively in this dryer

The dryer consists of a concrete foundation with a hollow center filled with tamped sand; twenty 1,000-watt G. E. strip heaters with terminals at one end; and the drying pan proper, 4 ft. wide by 8 ft. long by 13 in. deep, made from sheet iron. The strip heaters rest upon an asbestos board and between asbestos spacers slightly thicker than the heaters, as shown in the accompanying sketch, to reduce heat losses to a minimum and to allow free removal or replacement of the strip heaters. Power is supplied at 220 volts, and the supply leads are made from No. 10 black asbestos-covered wire. The projecting heater terminals are insulated with asbestos tape and covered with No. 1201 glyptal paint. The strip heaters are arranged in four circuits, each circuit being controlled by an individual switch to insure uniform heat under the pan. Obviously, these switches can be replaced by contactors controlled by a thermostat.

Drying time depends upon the depth of the precipitate in the pan. With 6 in. of precipitate in the pan, the drying is accomplished in less than eight hours. The pan is secured to the concrete base by four ⅝-in. bolts to prevent warping, and the padlocked screen covering the top of the pan prevents theft.



The position of the heating elements is illustrated in these two views

Ventilating Raises and Stopes Through Boreholes

Nacozari practice modified to good advantage in the Bussieres mine, Quebec

Charles F. Jackson

Superintendent, Bussieres Mine, Senneterre, Quebec

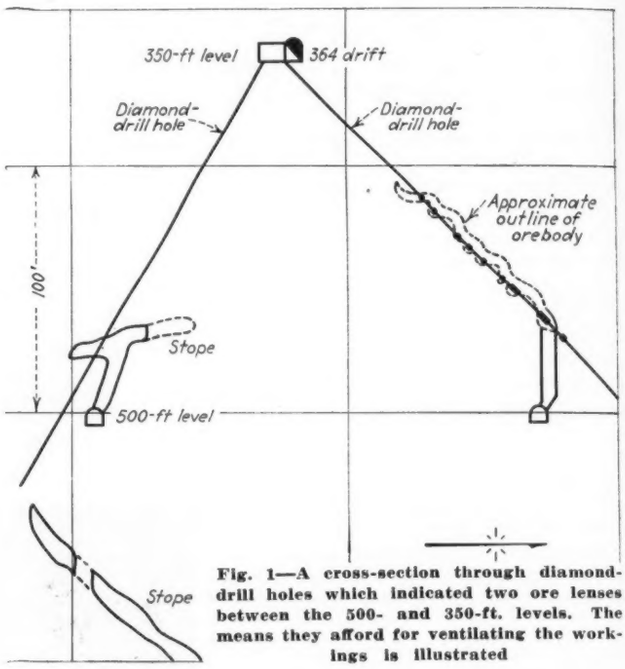


Fig. 1—A cross-section through diamond-drill holes which indicated two ore lenses between the 500- and 350-ft. levels. The means they afford for ventilating the workings is illustrated

THE METHOD of using diamond-drill holes for ventilating new raises and stopes at the Bussieres mine, in Quebec, is an adaptation of a scheme employed at Nacozari, Sonora,[1] Mexico, for ventilating individual long raises through boreholes, to a system for ventilating a series of raises and connecting stopes.

The ore lenses are flat-lying and their position is usually ascertained by diamond drilling, the latter fact being pertinent to the present discussion, inasmuch as the system involves exhausting from the stopes through the exploratory drill holes. Fig. 1 is a cross-section through drill holes which indicated two ore lenses between the 500- and 350-ft. levels. Other sections along the strike are similar. The drill holes are approximately 1½ in. in diameter.

In developing these lenses it is customary to drift to a point below the lowest ore intersections in each drill hole and then raise to the ore. In the case illustrated, the ore lies some distance above the 500-ft. level and in the north lens probably terminates about 75 ft. below the 350 level (as measured on the dip) and in the south lens about 120 ft. below the level.

Were the ore continuous between levels, stope ventilation would be secured through raises to the level above, which would be driven from level to level in the course of blocking out the ore preparatory to stoping.

The lenses seldom extend from one level to the next, however, and, furthermore, the amount of ore which will be developed in a lens is problematical and may vary within wide limits either way from the expected tonnage based upon drill results. The ore occurrence is a story by itself. For the purpose of this article, suffice it to say that such are the uncertainties as to the ultimate productivity of a lens that the expense of driving long raises in waste to the level above ahead of ore extraction solely for ventilation is not warranted and that adoption of the method of ventilation here described has been found expedient.

As soon as a raise intersects the diamond-drill hole, an air ejector (Fig. 2) is connected to the hole on the 350 level. This ejector was evolved from the one described by Murl R. Schrock in the article previously referred to. The latter, however, was constructed for use either as an injector or as an ejector. After making three ejectors, each of which differed slightly in detail from the preceding one, that shown in Fig. 2 proved most satisfactory.

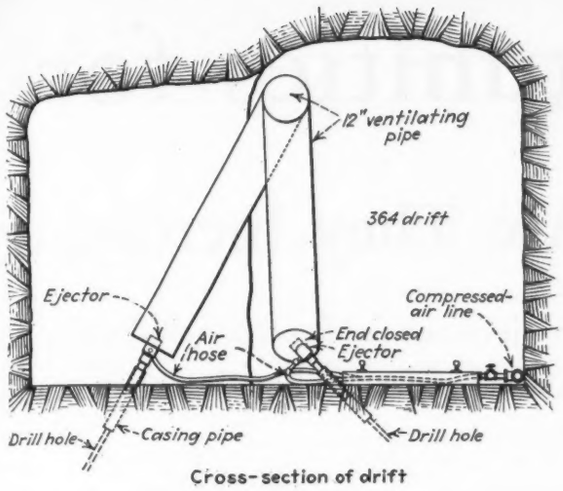
The ⅜-in. air inlet on the ejector is connected by a hose and through a valve to the compressed-air line. To place the ejector in operation it is only necessary to open the valve. With normal air pressure of about 85 lb., the suction created rapidly removes the gases produced by blasting in the raise or stope. Between shifts the air pressure is low, but it is built up again before the men re-enter the working places, so that the latter are quite free of gas at that time.

Inasmuch as work was going on in the 364 drift (see section, Fig. 1) the ejected gas had to be removed from it. A small exhaust fan at the collar of the shaft had been in use for some time for pulling gas from the levels after blasting at the end of the shift. It exhausts through a 12-in. galvanized iron pipe which extends down the shaft and is provided with tee-connections at each of the four levels. This pipe was extended on the 350-ft. level into 364 drift, and the ejectors were connected to it as shown in Fig. 3. Instead of the ejected gases being discharged into the drift, they are thus turned directly into the exhaust system and drawn to surface through the vent pipe, the 364 drift being thus kept free of gas.

This system has proved efficient, especially during raising and preliminary stoping operations, and has materially shortened the time required to open new stopes. Of course, its effectiveness decreases as the open-stope area increases, but inasmuch as the drill-hole sections are only 50 to 75 ft. apart, the stope faces at no time are at any great distance from a drill hole. The amount of ventilation which can be thus secured through a hole as small as 1½ in. in diameter is quite remarkable.

In this particular installation the expense involved has been very small. The 12-in. pipe was taken from worked-out sections where it had previously

[1]Schrock, Murl R.: "Diamond Drilling and Air Injectors for Raise Ventilation." *Mining & Metallurgy*, December, 1929, p. 567.



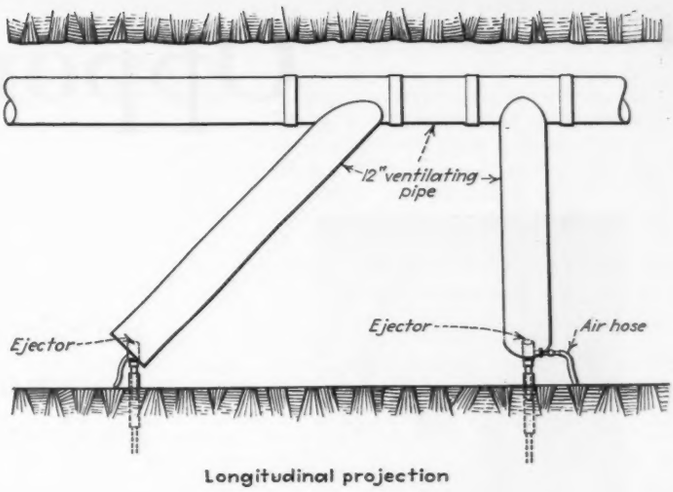


Fig. 3—Gases pulled out of the 500-level workings are ejected into this ventilating pipe in the 364 drift, which pipe discharges into the shaft. This drawing shows the way in which connection with the ventilating pipe is made. With normal air pressure of about 85 lb., the suction created rapidly removes the gases from raise or stope

been used, and the ejectors were made in the shop at a cost of about $17 each for labor and material. In operation much less compressed air is required for the ejector than for open blowing in the stopes.

The ejectors must be cleaned every few days, because they pull up considerable dirt in the form of rock dust, and even pieces the size of a grain of wheat, which become lodged in the annular space around the cone, thus plugging the compressed-air inlet. Aside from this they require little attention.

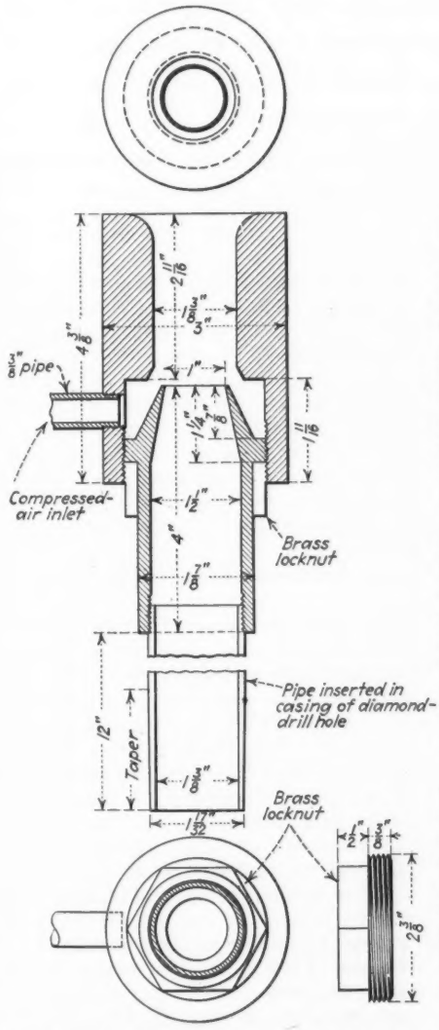


Fig. 2—This air ejector is connected to the collar of the diamond-drill hole at the 350 level (Fig. 1) as soon as a raise from the 500 level intersects the hole.

Quartz Reefs Principal Gold Source In Musoma Field, Tanganyika

GOLD occurrences in the Musoma District in the northern part of Tanganyika Territory on the eastern shore of Lake Victoria and directly south of the Kenya border have been studied by the Geological Survey at Dodoma, which has just issued a bulletin (No. 7) outlining the geology. The district covers approximately 6,200 sq.mi., of which 2,070 sq.mi. has been geologically surveyed. The conclusions of the Geological Survey are as follows:

A thick series of basic and acid lava flows and associated sedimentary deposits with banded ironstones prove to be the most extensive of the oldest rocks of the district. Some of the banded ironstones have been shown to have originated by ferruginization and silicification of felsitic tuff. Another type is definitely of sedimentary origin and consists really of magnetite-quartzites.

Gold deposits have been found associated with the banded ironstones, but probably only where dikes and quartz stringers have impregnated them locally with gold. Quartz reefs are the principal auriferous rocks in the district, and these are offshoots from the parent magma of G.3 granite. These reefs are located chiefly (a) near the contact of the granite and the older formations, and (b) in the Tombstone formation. Reefs are also found in the altered gabbros and in the complex of the East Mara region. Most of the visible gold is secondary—having been derived from the oxidation of primary auriferous pyrite. The treatment of the latter requires fine grinding and cyanidation to yield a good extraction.

There is a probability of continuity in depths of most of the reefs, but until deeper mining has been carried out it is impossible to forecast values. Those reefs at the contact with the granite in the greenstones are liable to be cut out by the granite in depth. Enrichment of most of the reefs by residual and secondary processes is everywhere evident. It is necessary to be prepared therefore for a falling off in values in the first 25 ft. from the surface, especially where visible gold and manganese dioxide have been deposited together in the reef-rock. This does not hold where the leached zone is shallow and very little oxidation has taken place.

Discovery of any valuable alluvial deposits of gold is considered unlikely. The drainage—except for the area north of the Utimbaru Scarp—is mature.

The bulletin concludes by giving prospectors advice as to where to look for gold. Underground water level has not yet been reached in any of the workings in the field. It is thought that on the peneplain level the depth to underground water will be about 160 to 170 ft. Geophysical methods of prospecting may prove useful over certain clays, loam and laterite at the base of the hills, where there is no great overburden and where reefs may be hidden.

Opportunities for

Are They Increasing

An Educator views the field and concludes that in the next thirty years they will be at least as great in the United States as now

E. A. Holbrook

Dean, School of Engineering and Mines, University of Pittsburgh, Pittsburgh, Pa.

Considering the far-flung line of American mining interests, Dean Holbrook believes that 200 young mining engineers a year, such as were graduated from standard mining engineering courses in the United States in a recent year, are insufficient to make up the loss of those older men who retire or die, let alone those who move into general executive positions, or to supply the additional men needed because of the increasing difficulties of mining work. He appeals to operating executives to give attention to the young mining man, lest the supply decrease below the present "danger point."

WHEN a college professor writes on this subject, members of the profession and perhaps the public are prone to think that it is a bit of propaganda designed to boost enrollment of students in mining schools. Therefore, I hasten to add that throughout the country the total student enrollment in schools of mines has held up very well during the years of depression, especially when compared with engineering schools in general, or with other schools, such as business administration or liberal arts.

If you examine carefully the enrollment statistics of many mining schools during the past ten years you will note a decided and growing shift away from the straight mining engineering course to newer branches and courses offered under the titles of metallurgical engineering, petroleum engineering, petroleum geology, fuel technology, and others. Some mining schools have expanded and are offering courses and degrees in civil, mechanical, and other branches of engineering. Through all these changes can be detected a gradual decrease in numbers of students taking what the older professional man knows as straight mining engineering. By this term I mean men who are preparing to enter the mining industry, as distinguished from the metallurgical or petroleum industries. The decrease continued until in 1932 all the standard mining engineering courses in the country graduated only about 200 men.

I raise the question of what has happened and why, having in mind not only the future of our mining engineering courses but what our mining companies are to do in the years to come without a steady supply of young trained men. Can any man acquainted with mining doubt that as long as we have civilization we shall have mines, or that the older and deeper our mines, the greater the number of men trained in mining we shall need? Considering the far-flung line of American mining interests, 200 young mining engineers a year do not make up for the loss of those older men who retire or die, let alone those who move into general executive positions, or the additional men needed because of the increasing difficulties of mining.

I talked the other day with an executive who told me that his company often took men trained as civil or mechanical engineers, and made them over into mining engineers. Is it possible, therefore, that we have been wrong all these years in educating men in mining engineering, and that the profession is soon to be classed as extinct, along with the Dinoceras and the dodo? Is it possible that the need that led to the establishment of the Mining Academy at Freiberg, Germany, in 1765, as the first technical school in Germany, or that prompted the work at Columbia and other fine old schools in this country, has passed by? Is the American Institute of Mining Engineers to become the American Institute of Friends of Mining? Is mining engineering as a professional study and practice to sink to a relatively insignificant place? Mining, next to civil engineering, the oldest of the engineering professions!

Erroneous Popular Notions

In some way the notion that mining engineering is decreasing rapidly in importance has spread to the public and especially to recent popular writers. Walter B. Pitkin has recently written a book, "New Careers for Youth," which is extensively read and used by high-school vocational advisors and other public educators. So important is his statement (p. 102) concerning mining engineering that I quote it in full:

"The mining engineer is disappearing chiefly because of the old rule that the profits of mining decline rapidly with the age of the mine. The newly opened mine has ore close to the surface and can therefore be worked cheaply. The longer it is worked the more inaccessible the ore. In England today many of the old coal mines which paid handsome profits to their owners for sev-

Mining Engineers . . . or Decreasing?

eral generations are now worthless, simply because the rich beds ot coal which still remain are so deep that the heat and the inflow of water make the extracting of coal too costly.

"This has now been going on with our anthracite coal, our copper, some of our gold and much of our silver. The Katanga copper mines of Central Africa not only have very cheap native labor, but the ore lies at hand. So, too, with many deposits of copper, silver, and gold in Mexico and South America, and the great Russian platinum deposits.

"Whenever a mine closes up, several mining engineers lose their jobs. They find new ones today only by going to the ends of the earth."

I hasten to add that Dr. Francis A. Thomson, president of the Montana School of Mines, wrote to Dr. Pitkin and called his attention to inaccuracies in the statement and that Dr. Pitkin graciously replied that in the next revision of the book he would make changes in the section to which Dr. Thomson took legitimate exception. Nevertheless, right or wrong, it appears that in the popular mind something is out of gear with mining engineering.

But we have a statement much nearer home. Dean C. C. Williams of the College of Engineering, State University of Iowa, last year published a book, "Building an Engineering Career," which has been read extensively by young men and is widely used in vocational advisory work in the secondary schools. He states (p. 24): "In general it may be said that, for the most part, mining engineering is an assembly of rather elementary operations in the other branches of engineering, and with the growth of large mine owning corporations, which have been inclined to pool their engineering operations, the field for the mining engineer has tended greatly to decrease." Small hope to be found here for a boy who is thinking of a lifework in the mining engineering field.

Importance of the Mining Industry

As I look pessimistically at the two books just mentioned I note on my desk a blue covered booklet just issued by the American Mining Congress, "The Unseen Empire," and I note in it the statement that minerals form the source of half the nation's wealth. I also note that mineral producers pay almost six times as much as farmers in federal taxes; that at least 800,000 men work underground in our mines; that coal mining alone gives employment to more men than any single manufacturing industry and that the number of miles of track laid underground in Pennsylvania mines is greater than the mileage of railroad tracks spread over the surface of that State; and then I read of the extent of our lead and zinc, copper, gold, silver, and other metal mining and of the vastness and diversity of our quarries and non-metallic mineral production, and I wonder. Is this vast mineral industry, on which rests our industrial civilization, somehow learning how to function with fewer and fewer specially trained men while the history of all other industries shows a decided increase through the years of technically trained men? As our mines get deeper and larger, with increasing problems of operation and management, do the technically trained men have less and less to do, or have we become in reality "An Unseen Empire" which is no longer romantic and of public interest and which has, therefore, been dismissed from the mind not familiar with mining?

What a generation of American mining engineers were produced at Columbia, Massachusetts Tech, Lehigh, Houghton, Rolla, Golden, Berkeley, and Stanford in the eighties and nineties! One could list hundreds of names of their graduates who became high executives in great mining companies, or who carried successfully American mining methods to Asia, Australia, South Africa, Mexico, and South America. Perhaps it was the very success of these men which led, in the early years of this century, to the establishment of schools or departments of mines in most of the mining states. In turn, each of them can show an honorable list of graduates who have been successful in the mining field.

Recently I considered the mining graduates of my own school whom I had known while in college some 30 years ago and compared them with graduates I had known in other engineering courses. My conclusion is that, on the whole, mining graduates have succeeded as well as those from the other courses. I also have the list of mining graduates from 1900 to 1910 of a Pennsylvania school of mining, most of whom entered the coal-mining field. There is no doubt that today most of these men have made a success in their chosen profession. It is true that they no longer are surveying mines, or doing field geology, or designing headframes—the things they learned to do in school. They have passed beyond that stage into managership and ownership of mines, or into business dependent on or closely affiliated with mining. As I compare these men with a like group who graduated at about the same time in another engineering course, the conclusion is inescapable that the good, old, straight mining engineering course has proved itself a worthwhile college foundation.

Cycles of Mining Engineering Education

It appears that mining engineering education has been subject to several interesting cycles of growth. Some of the older men I used to know had gone to Germany in the seventies and eighties to get their mining education. The development of American schools made this unnecessary, and after 1900 we find few young Americans studying mining abroad. In turn, up until about 1900, many Western boys came East to study mining, but, shortly thereafter, the development of mining schools in their own States or region made this unnecessary. In numbers of students, practically all American schools increased rapidly, reaching a first peak about 1907. At that time the so-called business panic caused many mines and mining developments to close, and for the first time we had an oversupply of trained mining engineers. For the next few years mining school enrollments did not on the whole increase. By 1911 the panic had been forgotten and the mining schools again were forging ahead. Indeed, the number of such schools or departments had multiplied until there were close to 50 in the United States. There was another general slump in mining about 1914 and an excess of mining engineers on the market, which, in turn, led to a decrease in numbers of young men wishing to enter the profession.

Then came the War, with its attendant demands on the products of the mines. Mining prospered and mining schools grew in size. Parents would come to me as though in possession of a great secret and tell me they had discovered that mining engineering offered a great field of promise for their sons. It mattered not if the son was sickly and anemic or if he had never seen a mine or been in a mining district. There was magic in mining engineering. Judged by enrollment in mining courses, this feeling must have been general throughout the country. From 1919 to

1922, when I was with the Bureau of Mines in Washington, not fewer than six college presidents or officials came to talk over the establishment of mining engineering courses at their schools. This irrespective of the fact that there were other colleges in their neighborhood offering mining. They all said that there seemed to be a great demand for mining education among the boys who applied for admission. Out of the six only one school seemed justified in starting a mining engineering course.

Then came a mining slump in 1921, to be followed in two or three years by the usual slump in boys wanting to follow mining. By the time the prosperity of the twenties was under way, a new factor had appeared in mining schools. The industries and the public had discovered metallurgy during the War. Up until that time metallurgy in most schools had been an adjunct to mining, say a few courses to enable the mining engineer to concentrate or refine the ores he produced, or to outline for him the general process of producing steel and other useful metals. Then came the developments in metallurgy that caused this subject to leave its old orbit of mining and to progress under the new influence of chemistry and physics. No longer does a course in mining engineering fit a boy to enter metallurgical work; he usually wants and receives a four-year undergraduate course in metallurgical engineering.

Call of the Petroleum Industry

Beginning about 1915, the petroleum and natural-gas industries rapidly changed from the rule-of-thumb methods to scientific and engineering methods in prospecting, production, and refining. The first call was for men trained in geology. Then came a demand for engineers who could be trained in drilling and production, and more recently there has been a demand for engineers with a good chemical background for refinery work. The first to answer these calls were many mining engineers, with their background of mineral location and production, backed by the ability to "rough it." By 1925, the mining schools and departments were meeting this demand by courses and degrees in petroleum and natural-gas geology and engineering. Today in many schools enrollment in the mining engineering department is smaller than in either the metallurgical or petroleum engineering departments. In my own School of Mines more than half of all the students are taking petroleum engineering. I make this statement, not to show an increase or a decrease in enrollments in any departments in colleges, but to inform executives of both metalliferous and coal-mining companies that the supply from mining schools of young men trained in mining engineering is likely to be less than was the case a few years ago.

I have asked many mature engineers the question, Why did you take mining engineering when you went to college? Though in a few cases the answers were that they came from mining families or had worked in mines before they went to college, the majority have said that they were attracted to mining by its seeming possibilities of romance and adventure, and the appeal of a life in the great outdoor spaces. They mostly were boys from non-mining communities and without mining background. These same restless, rugged individualistic boys today do not usually select mining engineering. A considerable number of them want aëronautical engineering, and many others who a few years ago would have selected straight mining now are appealed to by the possibilities of petroleum engineering.

It is well to admit that in past years many a boy who graduated in mining did not long follow it; a year or two in camp was enough to wash off the glamour; the girl he wanted to marry was accustomed only to city life or his physical body was not intended for the kind of life he had to lead. Often promotion was so slow that there was more opportunity in other engineering or business work. In any case, a mining engineering education, by reason of its very broadness, has been the foundation for success for men in many lines of endeavor.

Let us look at conditions during recent years. Throughout the prosperous twenties the demand for electrical, mechanical, and many other kinds of engineers increased enormously, as did the number of students taking these courses. The more prosperous and diversified industry became, the more engineers it demanded. During this same period, mining was having a spotty existence. Gold mining slumped, for reasons known to us all. Coal mining had its own pre-depression decline, beginning as far back as 1925. Zinc, lead, copper, and iron mining in general were prosperous and able to absorb their proportion of mining engineers. A most favorable sign was the demand from the non-metallic mining industries, as salt, gypsum, and talc, for young mining engineers. Out of this conflicting evidence one point is clear, that the demand for young mining engineers during this period did not approach the rather frenzied demands of many industries for other kinds of engineers. As a result, enrollments in straight mining engineering did not increase during this period; on the contrary, they tended to decrease, taking the country as a whole. In this connection it should be remembered that the low point in number of mining graduates, reached in 1932, was not due to any slump in mining that year but was a reflection on general mining conditions in 1928, the year in which they entered college.

During the years following the crash of 1929 we who follow engineering education noticed that the demand from industry for most kinds of young engineers fell off rapidly and became spotty. However, the demand for young mining engineers continued steady and about on a par with what it had been during the years of prosperity. During the past five years many young engineers of all kinds from many colleges have come to my office asking if I knew of any jobs or positions in the Pittsburgh district. It is significant that only one or two of these applicants have been mining engineers. Likewise, contact with other schools of mines leads me to make the statement that during the depression the placement of young mining engineers in mining work has been better than the placement of most other kinds of engineering graduates. These facts soon reach young men, and the result has been a steadily increasing enrollment in mining engineering in the past three years.

Students Enrolled Increasing

Professor W. B. Plank, head of the mining department at Lafayette College, Easton, Pa., in a report on "Registration in the Mining and Metallurgical Schools," given this year at the February meeting of the A.I.M.E., notes that the number of freshmen in American mining schools had increased from 1,105 in 1932-33 to 1,583 in 1934-35, a 44 per cent increase in two years. The total student bodies in these schools increased 22 per cent this year over last, an increase that never has been exceeded in one year. He further states: "There has been a steady improvement in the employment of the graduates of our mining schools for at least the past three years. Of those who graduated in 1932, at least 50 per cent obtained positions on graduation or went to graduate schools. Of the class of 1933, 80 per cent were employed or in graduate schools about six months after graduation. The figures for the class of 1934 report that 86.4 per cent are employed or in graduate schools. For Canada the reports show that all of last year's graduates are employed or in graduate schools."

On my desk is a statement from the dean of a Western mining school that he is unable to supply enough trained mining men to meet recent demands. He notes that the requests for men have come not only for positions in the United States, but in foreign countries as well. Another mining professor, in a personal letter, regrets that so few men have taken mining engineering during the past few years, as he could now place more than he has available.

Out of my general picture of the situation in mining engineering I can see the mining industry following a sine or a wave curve with years of prosperity followed by troughs of depres-

sion. I can see placements of young engineers closely following this curve. With a lag of four or five years, I see a similar curve which represents youth interest in becoming mining engineers. As I follow the professional careers of those who graduated in mining 25 or 30 years ago, I make up my mind that on the whole they have been as successful as a like group in other branches of engineering.

As I think of life and work underground I am convinced that special training is needed to follow and to direct it successfully. I hope young men will not enter it without any sort of previous contact with mining and because they think it is romantic. I do wish that an increasing number of young men from mining families and with some mining background would direct their education to a life work in what is, after all, the necessary foundation industry as long as we shall have an industrial civilization.

In an educational way I regret that so many undergraduate courses in mining have been static for so many years, not properly taking account of changing conditions in the industry and of new source material. For example, today, as preparation for most mining industries, a good course in safety engineering can be of greater importance than a course in assaying. I can see also that with the varied engineering professions open for study to the young man, mining engineering should become more specialized in its own field.

Mining Engineers Will Be Needed

Large mining companies will continue to hire electrical and mechanical engineers, but if they are to continue in mining, it seems reasonable that they will also continue to engage mining engineers. As for small mining companies I am sure that many have one or more men trained in mining and that many others would have avoided extinction had they employed a trained mining engineer. In spite of the present boom in gold, we should not suddenly begin to train mining engineers for this specialty only. The coal-mining industry alone should be able to absorb at least half the mining engineering graduates of any recent year. In addition, the lead, zinc, copper, iron, and other metal and non-metallic mines must have their quotas.

To executives of operating mining industries I make the plea that they give attention to the young mining man, lest the supply decrease beyond the present danger point. In this country today there are more mines than there were 30 years ago, and 30 years hence there will be at least an equal number. The search for minerals and metals will never cease. Manufacturing industries of all kinds will come and go, but, like the brook, mines and mining must go on forever. If, as our critics say, mining engineering is dying, we must have men of the same knowledge and experience, by whatever name we call them.

Acknowledgment is due Professor W. B. Plank, head of the mining department of Lafayette College, Easton, Pa., for much of the material used in this article.

New Flotation Reagents

POSSIBILITIES of developing better frothing agents in flotation have been overlooked, according to R. S. Dean, of the United States Bureau of Mines, and A. B. Hersberger of the University of Maryland, in T.P. 605, published by the American Institute of Mining and Metallurgical Engineers. Those hitherto available have been far from ideal. To be ideal a frother (1) must form in low concentrations a copious but not too persistent froth; (2) must froth equally well in an acid or alkaline medium; (3) must be insensitive to salts, even in high concentration; (4) must be absolutely non-collecting to both sulphides and non-sulphides; (5) must be such that its frothing properties will not be affected by collecting reagents, including soap; and (6) must readily emulsify and disperse any insoluble collecting agent likely to be used.

Emulsol reagent, X-1, has been selected as typical of these reagents and has been used almost exclusively in test work. It froths readily in amounts of 0.2 lb. per ton of ore, using a 20 per cent pulp, in either acid or alkaline condition. The froth is somewhat more watery than the usual froth and was absolutely barren when any of the common sulphide or non-sulphide minerals except graphite or talc were used at 65 mesh. By the use of oleic acid as a collector calcite, rhodochrosite, spatite, and scheelite were readily floated. The reagent concentration was as follows: X-1, 0.25 lb. per ton of ore; oleic acid, 0.25 lb. per ton of ore; sulphuric acid, 0.1 lb. per ton of pulp. By increase of acid concentration a point is reached where each of these minerals is depressed. Thus a flotation process is available in which relatively high acid concentrations can be employed as a means of obtaining selectivity. Results obtained for pure minerals are at best only a qualitative guide in working with actual ores. Sodium carbonate and sodium silicate were without effect on the frothing qualities of the reagent, and it could be used satisfactorily even in saturated brine.

Use of the reagent in testing on actual ores is illustrated by following examples: A kyanite ore, consisting of kyanite, quartz, limonite, rutile, garnet, and clay, was ground through 40 mesh and the kyanite was separated from the quartz in a slightly acid circuit by the use of 0.2 lb. X-1 and 0.02 lb. oleic acid per ton. This concentrate was contaminated with iron minerals. The flotation of the latter was inhibited by ball milling with the 2.0 lb. sulphuric acid per ton and a little X-1. Results of a single flotation after such conditioning were: concentrates (Al_2O_3, 6051 per cent; Fe_2O_3, 0.49; and quartz, 0.62), 14.8 per cent by weight; middlings, 16.6 per cent by weight; and tailings (3.79 per cent Al_2O_3), 68.5 per cent. by weight. A Fahrenwald Sub A machine was used.

Separation of hematite from quartz has never been satisfactory in ordinary soap flotation, because of the activation of quartz by the iron salts. Use of the present reagents as frothers permits operation in a more acid circuit, and it has been found that 0.2 lb. per ton of acid is enough to inhibit quartz flotation when oleic acid is used as collector. The froth is not well suited, however, to carrying large amounts of fairly coarse material, and Messrs. Dean and Hersberger prefer to use smaller amounts of soluble oils as collectors, which is made possible by the emulsifying power of reagents like X-1. In this way quantitative separation of synthetic mixtures of quartz and hematite may be made. The degree of separation in actual ores is determined by the extent to which coating of the quartz by fine iron-oxide particles can be prevented.

Satisfactory tests were also made on a graphite ore, phosphate rock, a chromite ore, and sulphide ores, these demonstrating that virtually all minerals that have been floated can be treated using the new reagent as frother.

The properties of X-1 permit use of collectors not heretofore possible; for example, the insoluble paraffine oils, employed in many processes which immediately preceded froth flotation and which are facilitated now by use of X-1 as an emulsifier, so that they can be carried out in acid, alkaline, and brine circuits. The great emulsifying power of X-1 permits the use of these insoluble oils as selective collectors in froth flotation processes also, opening up a large field of possible new collectors.

Another group of new collectors, starting with oleic acid and proceeding by modifications to sulphonated oleic acid and thence to the butyl ester of the latter, is also made possible by the use of X-1 as a frother.

Alloy Cast Irons Win Place

High strength, hardness, and toughness, increased resistance to wear and abrasion, and to heat and corrosion, characterize these materials

B. H. Strom
Metallurgist,
New York

Among the metallurgical achievements of the last decade the development of the high-quality cast irons stands out. Great advances have been made by proper alloying, particularly with nickel, chromium, and molybdenum. The benefits have been twofold: New engineering materials with properties far superior to those of plain cast iron have been provided, and important outlets have been created for the alloy metals used.

THOUGH cast iron has always been looked upon as a low-quality engineering material, selected mainly for its low cost and ease of production and fabrication, many important developments during the last decade have so improved its physical properties that the usefulness of the metal is constantly being extended into new fields. Increased resistance to abrasion and wear; to moderately elevated temperatures; to oxidation and growth, and to corrosion, creep, and flow; greater hardness, strength, and impact resistance; more uniform structure and improved machining properties are among the qualities obtained by use of suitable alloy additions and proper foundry technique. In the mining and metallurgical industries, where materials of construction possessing these improved properties are in great demand, the new alloyed cast irons have naturally found wide application, and as the men of the industry become more familiar with their performance, under the various conditions in their fields, an even greater expansion in their use may be expected.

No single definition adequately applies to the term cast iron, which includes a multitude of products, generally high in carbon and silicon and frequently quite hard and brittle. Ordinary pig iron, for instance, belongs to this group. Another well-known type is the white cast iron, in which practically all of the carbon contained is held in chemical combination with the iron, as iron carbide, or cementite, a very hard and brittle compound. A suitable analysis combined with rapid cooling against a metal chill instead of in sand insures the presence of this carbide. Proper compounding of the common constituents and the addition of chromium and nickel may accomplish the same.

In gray cast iron the carbon is partly present in the form commonly known as precipitated graphite, in a matrix of ferrite, pearlite, or some other structural modification. Gray iron is much softer and easier to machine than the white variety. Its strength depends on the type of the matrix as well as on the distribution, size, shape, and quantity of the graphite. Graphite itself possesses very low physical strength, and a graphite flake may for all practical purposes be considered only a void in the casting where tension is involved. Small size and even distribution of the flakes are therefore essential to a good quality of cast iron.

The progress made in the development of alloy steels naturally suggested the use of similar alloying agents to improve the qualities of cast iron, although no absolutely identical effects could be looked for in view of the inherent difference between cast iron and steel, and the difference in heat-treatment. The metals found most effective for this purpose are nickel, chromium, molybdenum, and manganese. Hand in hand with the application of alloying constituents have come a more intelligent furnace operation, and better control of pouring temperature, molding, and gating practice. Application of heat-treatment, and the introduction of X-ray inspection, have permitted a steady increase in the quality of the castings produced.

Nickel is the most widely used alloying element in this field. Last year about 4 per cent of the world's nickel production was used for this purpose, compared with 2.7 per cent in the preceding year and 1 per cent in 1926. It dissolves in the ferrite in any proportion, and it also affects the carbon by acting as a graphitizer, thereby eliminating chill and improving the grain refinement and machining properties. The graphitizing action is about half that of silicon. With amounts of from 1 to 3 per cent nickel, with one-half as much chromium, good strength and heat resistance are obtained. In combination with carbide-forming metals it increases strength and toughness, produces a uniform structure in castings of varying sections, and insures freedom from such troubles as porosity and local weaknesses frequently present in intricate castings. Higher contents of nickel also impart valuable properties of corrosion and heat resistance.

A further benefit from the use of nickel in cast irons amenable to heat-treatment is that the hardening effect penetrates more deeply into the thick sections, just as in the making of steel castings and forgings, where nickel secures penetration of heat-treatment through the heaviest masses of metal. The danger of cracking in light sections, under heat-treatment, is also materially reduced.

Chromium, in small quantities, combines with the carbon, forming extremely hard carbides with high resistance to abrasion and elevated temperatures—at the expense of the graphitic carbon, however. The size of the remaining graphite is much smaller than when no chromium is used. Up to 0.5 per cent, chromium, with a sufficient quantity of nickel, will increase the hardness without any appreciable loss in ductility. Above this point the hardness increases and the ductility declines.

Small additions of chromium increase the density and physical properties, and improve to some extent the resistance to high-temperature oxidation, but substantial resistance to highly oxidizing gases at elevated temperatures is obtained only by the use of higher percentages of chromium—15

in Mining

Pouring chromium cast iron. Addition of chromium is made directly to the charge, in the form of a briquetted alloy, placed on the coke, near the center of the cupola, to prevent excessive slagging of the alloy

per cent or more. When these high chromium irons are exposed to high temperature a stable oxide is formed on the surface, preventing progressive oxidation. Irons with 15 per cent chromium will resist oxidation up to about 1,500 deg. F., and 25 per cent chromium will widen the range of resistance to about 1,800 deg. F. Another type with over 30 per cent chromium has anti-corrosion properties similar to those of the stainless steels. These high-chromium irons are generally not machinable.

An important function of chromium is to limit growth occurring in castings subject to repeated heating and cooling. Such growth is caused by influx of oxygen along the graphite planes; as the oxide formed occupies a larger volume than the iron, some permanent expansion, or growth, will occur. Addition of 1 per cent chromium will eliminate growth up to above 1,400 deg. F., and smaller additions will have proportionate effect.

Despite the fact that molybdenum was first used commercially in cast iron late in 1928, its application today is of substantial proportions; present consumption is sixteen times that used for this purpose in 1929. Molybdenum increases the tensile and transverse strength, generally improving the deflection at the same time. The endurance limit of fatigue strength is also increased, as well as resistance to abrasion and creep at high temperatures. A pronounced increase in toughness, or impact strength, of gray iron is one of the outstanding characteristics of this alloy.

Molybdenum is not only effective when used alone, but it intensifies the action of other alloying elements and is therefore frequently used in combination with nickel or chromium, or both. It has a strong tendency to produce uniformity in large castings with great variations in sections. The tendency to close the grain and counteract shrinkage is of great value; additions in amounts up to 0.25 per cent are often made to castings which have a tendency to crack in the molds. It also improves high-temperature physical properties. Like nickel, it gives high machinable hardness in cast iron by strengthening the matrix. When used in combination with nickel it produces iron that can be commercially machined at hardnesses up to almost 300 Brinell. Molybdenum irons wear better than plain cast iron, partly because of the uniformity throughout the casting and partly because of the inherent toughness of the iron.

Copper, like silicon and nickel, acts as a graphitizer and decreases the tendency to chill. It has some effect on the hardness and increases the strength in compression, gives a much closer and more homogeneous structure, and improves the machinability. Alloyed with gray iron it increases the corrosion resistance. One of its most useful applications has been in combination with molybdenum in the development of an acid-resistant malleable iron. It is frequently included to replace part of the nickel, for economical reasons, but where the best properties are required experience so far indicates that the copper-free alloys are superior.

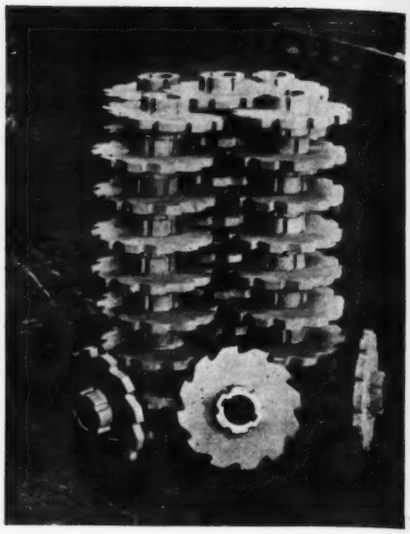
An iron which may be soft and easy to machine when used in castings of large dimensions may become very hard and difficult to machine in lighter castings or in sections of small dimensions that chill quickly. The composition must therefore be selected with the size of the section in view. These variations due to mass effect are greater in plain cast iron than in most alloyed types.

Ni-Hard, an extremely hard, tough, and strong white or chilled iron, especially suited for applications requiring great hardness and resistance to wear, abrasion, attrition, and deformation, has been on the market for three or four years. This iron, which contains 4 to 6 per cent nickel and 1 to 2.5 per cent chromium, has a hardness of 600 to 750 Brinell, against 380 to 530 for a corresponding plain chilled cast iron. It also has a high resistance to compressive loading and withstands corrosion fairly well. Commercial castings of this material include all sizes, from small grind-

ing-mill plates weighing but a few ounces up to heavy steel-mill rolls weighing several tons.

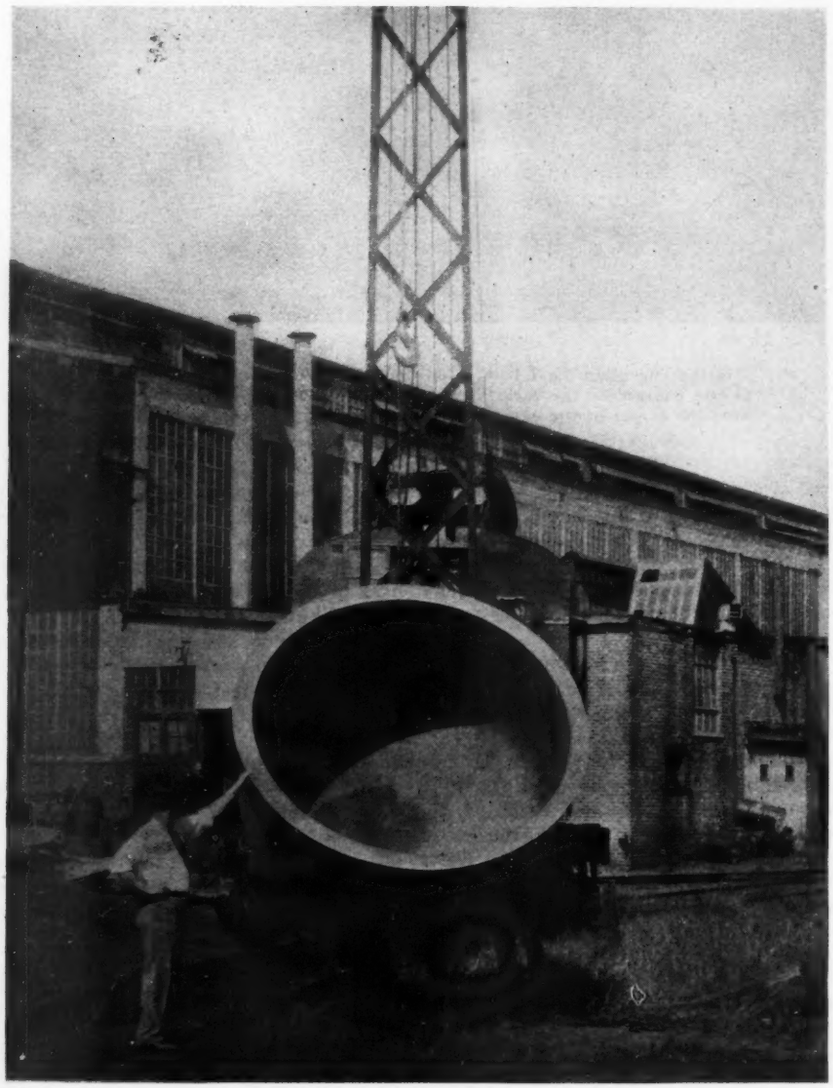
One of the first applications of this hard iron was in rolling mills, where it was found vastly superior to ordinary rolls, and frequently equal to the more expensive hardened and machined steel rolls. Wheels for mine cars and cranes show 50 to 200 per cent greater strength in the gray section and a wear resistance of the hard, chilled surface that makes them outlast ordinary wheels many times. Castings for grinding-mill service, such as plates, liners, and balls, have been found to have a life more than six times that of similar castings of plain iron. The sand pump problem, to give another important example, has become less trying through the use of Ni-Hard. Casings, impellers, and other parts of pumps handling highly abrasive, and occasionally corrosive slurries, when produced from this material, have furnished many times the life of the conventional chilled iron, and, under certain conditions, its useful life has appreciably exceeded that of an alloy steel. A single Canadian foundry has furnished over 1,000,000 lb. of this material in pump parts to mine operators in the northern Canada mining region. More than 75,000 lb. of the same material, in the form of crusher jaws, roll shells, ball-mill chute liners, and the like, have been in service in Mid-Western lead and zinc mines, and the results have been so satisfactory that orders for more than 200 tons of similar castings will soon be placed. Similar applications include pipe lines carrying abrasive slurries, conveyor trough lines, and various pump parts, such as plungers, impellers, impeller wearing rings, and throat pieces.

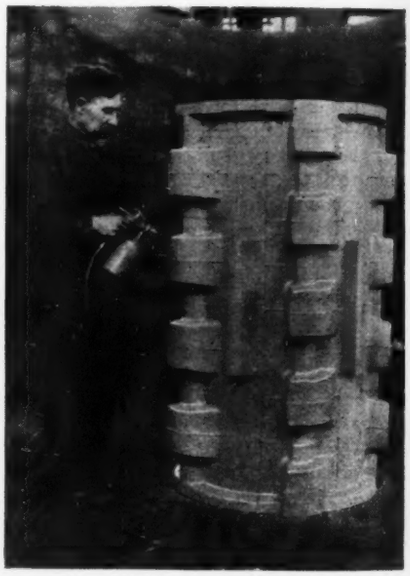
One company, after extensive tests to find a material for lining coke chutes, standardized on plates of this hard



Grizzly disks made of chilled white nickel cast iron, an extremely hard, tough, and strong material, with 4 to 6 per cent nickel and 1 to 2.5 per cent chromium, suitable for applications involving heavy abrasion

Lead-smelting pot of cast iron containing 2 per cent nickel, 1 per cent chromium, and 1.4 per cent silicon. Freedom from checking and grain growth insures long service life of these pots





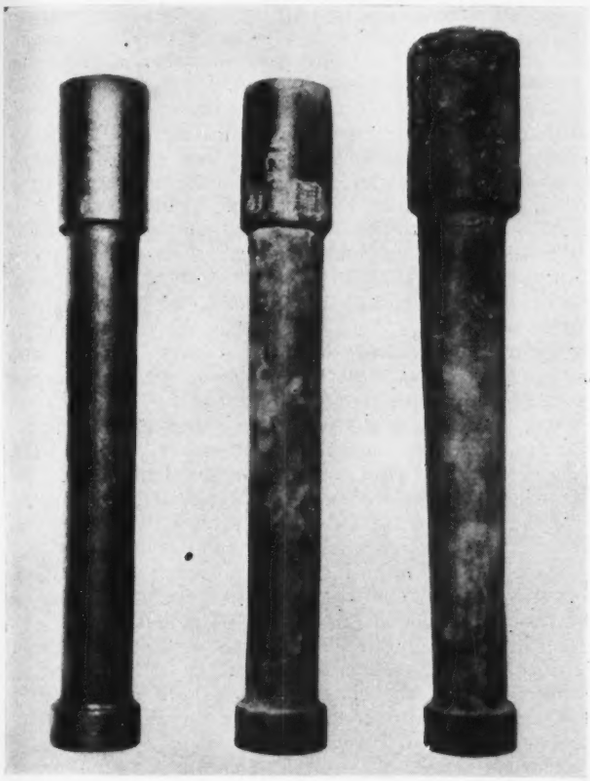
Five-foot crushing roll, weighing 6,500 lb., used for breaking Florida flint rock; made from white alloy cast iron containing 1.01 per cent molybdenum, 0.74 chromium, 3.58 carbon, 0.34 manganese, and 0.80 per cent silicon

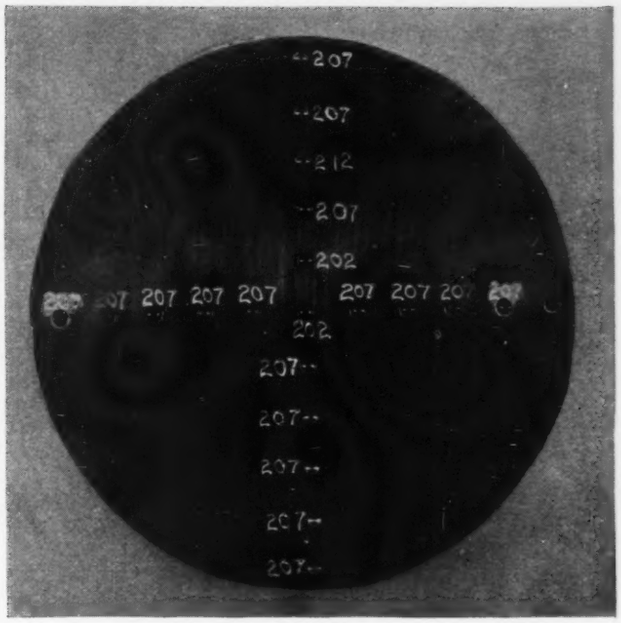
nickel cast iron and soon adopted it for other purposes, such as grizzly disks, wall plates, and slide castings where abrasion and wear caused rapid destruction of plain cast iron. These castings were still in good condition after one to two years' service.

Coke crushers equipped with segments of this cast iron have made excellent service records. Whereas a total output of 60,000 tons of crushed coke was considered unusually good service with plain chilled cast-iron rolls, a unit

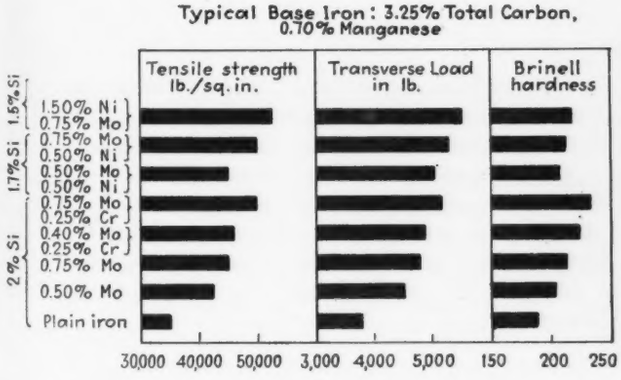
Pyrometer protection tubes for high-temperature service

1. **Tube made from 15 per cent chromium cast iron, before use**
2. **Same after several months' service**
3. **Tube of hard cast iron, made from same pattern and subjected to same service as 2, showing extreme growth and scaling**

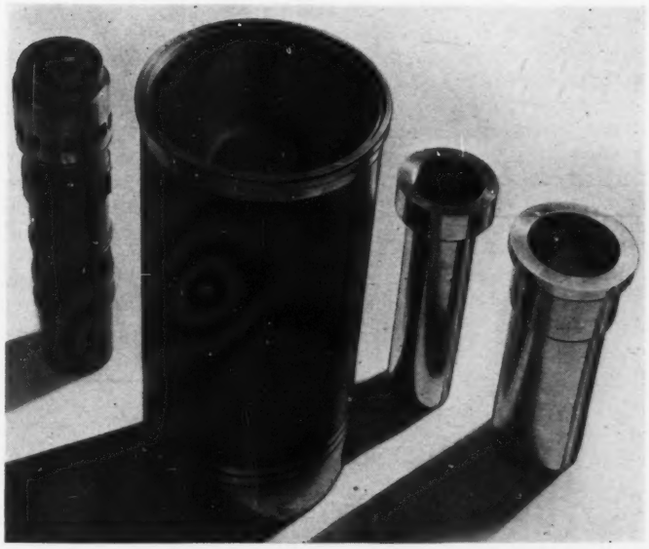




Brinell search on the machined cross-section of a 6¼-in. hydraulic ram, made of cast iron with 0.6 per cent nickel, 0.23 chromium, 0.58 molybdenum, 2.96 carbon, 0.91 manganese, and 1.46 per cent silicon. Note the remarkable uniformity of hardness throughout the entire section



Effect of various alloying elements on the physical properties of a typical cupola iron



Centrifugally cast nickel alloy iron liners used in oil and gas engines. Manufacturers of diesel engines make extensive use of this material

equipped with segments of alloyed iron showed such slight wear after handling more than 200,000 tons that an ultimate output of twice that figure, or even more, seemed well within reason. A conveyor tripper where a ½-in. plate of plain cast iron would wear out after 10,000 to 30,000 tons of material had passed through was found in good condition after handling over 250,000 tons.

The growing use of nickel cast iron is well exemplified by its application in heavy pieces such as 50-ton crusher frames. From that size down to castings for smaller crushers, weighing about 2 tons, the necessary strength and wear resistance are attained by alloying with up to 2.5 per cent nickel, alone or in combination with chromium and molybdenum. Tensile strengths as high as 60,000 to 70,000 lb. per square inch are obtained in the high-test types of nickel cast irons, as tested in the standard arbitration bar sections. A feature of special importance is the ability of these irons to retain a high proportion of this strength when cast in the extremely heavy sections, as formerly indicated.

This alloy is used in gears, valves, and fittings, pressure housings, and in highly stressed parts and where pressures are involved, such as in diesel-engine frames and flywheels, cylinders and cylinder liners, for all types of reciprocating engines, piston rings, gears and pinions, sheaves and pulleys, turbine casings, and valve bodies. On account of the reduced wear it is better

than steel castings for mine hoist drums. Superior resistance to shock and rough usage makes it a good material for gears and pinions.

Pots for melting lead, aluminum, and other metals, from a few hundred pounds' to about 10 tons' capacity, are also made of nickel-chromium cast iron and are frequently giving several times as long service as ordinary unalloyed pots. In lead smelters there is a trend toward low nickel-chromium cast iron pots, due to the superiority of this type in regard to checking and grain growth.

Ni-Resist, containing about 14 per cent nickel, 6 per cent copper, and 1.5 per cent or more chromium, is an austenitic type possessing a high resistance to heat and corrosion. Increased corrosion resistance is, generally speaking, a characteristic of most quality cast irons, particularly those of high alloy content and with dense grain structure. However, the complexity of the corrosion problem, and its many controversial features, prevent any standardized procedure. Each problem should be given individual attention. Unqualified recommendation of certain alloy cast iron for a given type of mine water, for instance, is not advisable without the precautionary measure of a thorough test in each specific case.

Among the applications for chromium cast irons those involving the heat- and oxidation-resisting properties are probably the most important. The element of abrasion resistance, frequently at elevated temperatures, is also one of the utmost importance. Where castings are exposed to gases containing free sulphur or sulphur oxides, the straight chromium irons are preferable to the nickel-chromium types, as nickel has a great affinity for sulphur. Rabble arms and blades for mechanical roasting furnaces are often constructed of chromium cast iron; some manufacturers specify castings with 16 to 18 per cent chromium and 0.75 to 1.0 per cent carbon. For very severe conditions castings with 22 to 25 per cent chromium and 1 to 1.25 per cent carbon are considered preferable. Usually, such arms and blades will outlast those of plain cast iron at least five times.

Grate bars for coal-fired furnaces and many oil and gas burner parts are now frequently made of chromium or nickel-chromium iron. Experience has shown that grate bars with 0.6 per cent chromium and 0.3 per cent molybdenum will outlast ordinary cast-iron bars about three times. The extraordinary effect of high additions of chromium with some molybdenum, for instance 20 per cent chromium and 2 per cent molybdenum, may be seen from the fact that such cast irons may resist temperatures up to about 2,200 deg. F., and also the attack of hot sulphuric acid. Heat-resistant cast irons are also finding applications in annealing and carburizing pots, tuyeres, fuel conveyors, coal plungers, fire-box linings, and high-temperature steam equipment. The great rigidity of valve bodies and parts made from this material prevents leakage where repeated opening and closing of the valves are called for.

During the last few years many manufacturers of large compressors and pumps have adopted molybdenum cast iron for cylinders and liners. As a molybdenum iron can be machined more easily than a plain cast iron of the same Brinell hardness, it is thus possible to produce liners and cylinders with increased wear resistance without any sacrifice in machinability. The high impact strength of molybdenum cast iron is also of value in these applications. Such pieces are sometimes heat-treated after machining, whereby a substantial increase in life may be effected.

Casting of gears is one of the difficult problems in foundry practice, due to the tendency to shrinkage at the inner rim and porosity at the base of the teeth. This difficulty may be overcome by adding some molybdenum, which serves to close the grain of the metal. For the same reason it is used in valves subjected to high temperatures and pressures; here the property of molybdenum of imparting high temperature strength to iron is also made useful. For this application a combination of chromium and molybdenum, in the ratio of 0.25 and 0.5 per cent, respectively, is frequently used. Cams and cam shafts of molybdenum cast iron are also finding wide application in the mining industry, both in as-cast and in heat-treated condition, on account of their remarkable toughness and wear resistance. From 0.25 to 0.5 per cent molybdenum in chilled-steel mill rolls toughens the iron and makes it retain its smooth surface longer between dressings. It has also a deep-hardening effect that permits more redressings before the rolls are scrapped. Other applications include rabble blades and stoker parts, heaters, sheaves and pulleys, exhaust manifolds, clutches, brake drums, and ingot molds.

Molybdenum is the only common alloying element combining with the carbides in white iron that toughens them. This characteristic results in improved wear resistance. Additions of 1.5 per cent are successfully used in combination with chromium, nickel, or manganese, in the manufacture of mill liners, grizzly disks, and other parts subject to excessive wear.

A new development is the use of chilled chromium molybdenum iron for grinding balls. Extensive tests have been made, indicating that these balls will offer appreciable reduction in grinding cost compared with forged-steel balls, and several Western mills have adopted this new type of ball.

Brains Versus Blasting in Removing a Casting From Cramped Quarters

AT AN ORE-DRESSING MILL in the Coeur d'Alene district, an 8-ft. ball-mill head, being worn, was to be replaced with a modern three-piece section. Unfortunately, in designing the mill no allowance had been made for the possible need of such a replacement, and no feasible way appeared of removing the casting from the cramped quarters in which it was located.

Knowing that the only manner whereby the large casting could be made to pass through a small opening was to reduce it to small pieces, the general manager considered various methods of accomplishing this objective. Jobs of this kind usually had been accomplished by the use of dynamite. In this instance, however, the risk of injuring the machinery and building property was considered too great. Accordingly he consulted an oxy-acetylene service operator, who promised to call and supervise the cutting of the casting by means of the oxy-acetylene equipment.

To convert the casting into pieces that could be readily handled, it was necessary to cut out the heavy trunnion bearing from the center of the ball-mill head. The casting itself was 4 in. thick, but in addition there were eight ribs running radially from the center to the edges. These were an integral part of the casting and were about 6 in. high and 3 in. wide at the point where the cuts had to be made. Thus about 14 linear ft. of cutting through cast iron 4 in. to 6 in. thick was necessary to remove the trunnion bearing. Two radial cuts were then made to sever the casting into smaller sections. Starting from the outer edges and running in toward the center circle, these two cuts totaled approximately 5 ft. in length.

Under the supervision of the service operator, the work was rapidly and easily done by only two operators. The actual cutting time was less than four hours for each man. The rapidity and low cost of dismantling by means of the oxy-acetylene cutting process was particularly gratifying to the mill superintendent. This was the first heavy cast iron cutting job to have been done in the district; the work is said to have been so satisfactory that it will undoubtedly not be the last.

NEWS OF THE INDUSTRY

NRA Loses—All Codes Voided As Supreme Court Rules

Mining and Other Industries Now Free to Conduct Their Respective Businesses as Before the Blue Eagle's Advent—Washington and Operators Weigh Decision, Reserve Action—Supporters of the Codes Seek to Retain Benefits

TAKING the whole nation and above all the National Recovery Administration and the multitudinous Code Authorities by surprise, the U. S. Supreme Court on the afternoon of May 27 rendered its unanimous opinion, in a test case that had been hand-picked by the Administration, that the National Industrial Recovery Act was unconstitutional. Section 3 of the Act delegating the code-making authority to the President was specifically so held on the ground that Congress had not limited or defined this authority sufficiently. Further, the provisions of the codes fixing minimum wages and maximum hours of work were also held invalid by the Court, which said that they were based on the idea that wages and hours of work affect interstate commerce. Such power the Court held would give the Federal Government substantial control over all activities. No constitutional right to regulate wages and hours of labor was possessed by Congress. These may effect only intrastate commerce and even though they may indirectly effect interstate commerce, the Federal statutes do not apply, otherwise the Federal power would be unlimited. The constitution does not provide for the Federal Government to control the internal concerns of a State.

At the time the opinion was handed down, the House Committee had already reached an agreement to recommend that the National Recovery Administration be extended two years, in contrast to the Senate's previously expressed desire for an extension of less than 10 months. The decision was immediately taken under consideration by both Houses as well as by the Administration officials in an effort to discover a course of action that would be within the constitution. The President lost no time in declaring the existing codes void and in setting the date of June 16 for winding up the affairs of the NRA offices and the code authorities. Business men, moreover, were appealed to preserve for the present the wage scales and hours of work set up under NRA.

Reactions of Executives —If Any

Mining executives who were concerned with the copper, lead and zinc codes before they crashed exhibited an attitude of watchful waiting or manifested no great concern. The day following the decision, the copper men whose code is signalized by its marketing provisions met to consider the situation and decided unanimously to take no action involving any change in the status or procedure under which they had been operating, pending further developments in Washington and the clarification of the situation.

The lead and zinc codes, in contrast, were only labor codes, containing only provisions relating to wages and hours of work. Their cancellation seems unlikely to affect their respective industries one way or the other. Executives of neither group had held a meeting up to the time of writing, nor formed an opinion—at least one that they would express. Wages in the lead industry, it was pointed out, have always been above the code minimum and on top of this a 50c. advance effective June 1 (see page 296) has been announced in the Coeur d'Alenes, in northern Idaho.

Although the zinc code authority had been tentatively set up, it had never been officially approved and no machinery for operation had been created, up to the time of the Supreme Court's ruling. Officials of this authority on coming to New York for their first meeting found that their recently approved code had been abolished. A strike in the Tri-State district, the first ever to be effective there (discussed below), had occurred 19 days before and was still in progress when the decision was announced.

Tri-State Workmen Strike

Mines, Mills, and Smelters Close, Affecting About 4,500—Operators Appear Unconcerned—Code Cancellation Unexpected by Union Leaders

WHAT is said to be the first effective strike ever to be called in the Tri-State zinc and lead district began at midnight May 8, when members of the International Union of Mine, Mill and Smelter Workers walked out. The call was made at meetings of the six locals, at Joplin, Galena, Baxter Springs, Treece, Picher and Miami respectively. Besides the mine and mill employees, men at the Eagle-Picher company's lead smelter at Galena, Kans., and its Smelter Hill plant at Joplin, Mo., are included. Approximately 4,000 miners and millmen and about 500 smelter workers are affected.

Objectives of the strikers are said to be "recognition, better working conditions and a living wage." Strike leaders claim that the operators refused to meet with them for collective bargaining. A form letter was sent out by the locals in April to all of the companies asking that a committee meet with the union heads to discuss this. Practically every operator has gone on record stating that no additional effort was made to obtain a meeting with the individual companies when this demand was ignored. The Galena smelter has been picketed continuously, some of the mines sporadically.

What effect the wiping out of the lead and zinc codes by the Supreme Court's

decision will have on the men and their leaders remains to be seen. Mine operators have shown but little interest. Almost every one was willing to see production shut off, as the district has been overproducing since Jan. 1, with the result that stocks have increased more than 10,000 tons in mine bins while smelters have added to stocks at plants. Prior to the code cancellation, more than 1,800 miners are said to have signed petitions stating their willingness to return to work under the conditions prevailing before the strike.

Construction on several tailing mills in the district was also suspended, as well as ore-hauling. Union strikers have stopped all efforts of buyers to load ore purchased the past few weeks. As a result, smelters have virtually suspended purchasing both lead and zinc concentrates and for the first time in the history of the field reported "no sales" on the week ending May 18.

Dewatering operations have continued in the Oronogo district. Frank Childress and associates have added a fifth pump and are preparing to add a sixth. More than 12,000 g.p.m. of water is being pumped and the additional equipment will boost this to 15,000 gal.

Silver-Lead-Zinc Prices Stimulate Coeur d'Alene Wage Increase

Idaho Mine-License Tax Law Halted—Steady Shipments Promised by Some Utah Camps—Base Survey of Comstock District, in Nevada, Under Way by United States Geological Survey—Mountain City Copper Cuts 20 Ft. of Low-grade Ore on Its 600-Ft. Level

OPERATING MINES of the Coeur d'Alene district, in northern Idaho, advanced wages 50c. per day on June 1. Those affected are the Bunker Hill & Sullivan, Hecla, Sunshine, and the Federal Mining & Smelting Company's Morning and Page mines. Approximately 3,000 employees are benefited, the order meaning a weekly increase of $7,500 in wages. Miners will receive $5.25, muckers $4.75, and outside workers $4.50. The Sunshine, a silver producer, pays a scale higher by 50c. than that of the lead mines in all departments, which means $5.75 for miners and $5.25 for muckers.

In making the announcement the operators stated the increased cost in all living commodities, such as groceries, meats, and clothing, had made such a step necessary. The increased price for silver, lead, and zinc was also a determining factor, and the new wage scale will depend largely upon the continuation of the higher market prices for metals.

All mines in the Coeur d'Alene district are working on a five-day week basis except the Sunshine, which operates on a straight seven-day schedule.

Operations of the Idaho mine-license tax law, passed by the Legislature in March, calling for a 3 per cent tax on net profits, have been halted by order of the district court, at Boise. Judge C. E. Winsted has issued a preliminary injunction *pendente lite* to halt collection of the tax following a hearing in his court. Arguments as to constitutionality will be made later. Passage and signature by the Governor have been severely criticized by mining and business men of the State as a deterent to inducing capital to develop new mines.

Hecla Mining is now on a five-day week basis, moving up from a four-day schedule in force for some time. This action places four of the principal producers of the district on the five-day basis—namely, the Bunker Hill & Sullivan, Morning, Page, and Hecla. The announcement affects close to 400 employees and adds around $2,000 per week to the payrolls of the respective properties.

Imports of Foreign Silver Coin Allowed Only Under License

In a spirit of cooperation with certain foreign countries, the Secretary of the Treasury has, with the approval of the President, issued an order prohibiting, except under license, the entry into the United States of foreign silver coins and other forms of silver commonly used as money. The reason for this is that, as the price of silver has risen, the silver content of the coinage of some countries has become more valuable as bullion than in the form of coins, tending to cause its destruction and sale as bullion. A usual method of dealing with this problem has been to call in silver coinage and change its silver content. An embargo on the export of the old silver coins is usually a necessary supplemental measure. Those participating in the importation into the United States of silver coins covered by such embargoes are aiding the violation of the laws of the country in question.

Suit has been filed by Bunker Hill & Sullivan seeking to collect $116,000 from the Ajax company for money advanced as a loan. The former's loan is covered by a mortgage against the property.

Jack Waite's main tunnel lacks 1,400 ft. of coming to the surface on the Montana side, according to recent reports. It is now more than 6,000 ft. in length, starting from the Idaho side of Tributary Gulch. A road from the Northern Pacific railroad, 14 miles distant, will be completed to the Montana tunnel entrance by the time the bore breaks through.

Plans to remodel the mill at the Golden Chest property, near Murray, to treat scheelite ore, are now being worked out. The mine has disclosed a considerable tonnage of tungsten disregarded in earlier operations.

Sunshine Consolidated has elected directors as follows: W. M. Yeamans, Frank Hardy, L. J. Burrows, all of Yakima, and Lester S. Harrison, of Kellogg, and Walter H. Hanson, of Wallace. Development operations are being conducted through the main shaft of the Sunshine company. A drift on the vein to the west is to be extended into the Consolidated ground from the 1,700-ft. level. Work is progressing at about 8 ft. per day. A face of good silver ore is reported.

UTAH

• Higher prices for silver and lead, the demand for gold properties, and spring weather have combined to stimulate mine development in Utah. From Tintic, Park City, Gold Hill, and Mercur come reports of new operations starting and promise of steady shipments.

Installation of new equipment to recover the gold from the base metal ores of Mercur has begun at the Manning Gold Mines mill, 5 miles from Mercur. To date, the plant has been treating only the oxidized tailings. A new kiln roaster, a primary and a secondary crusher, conveyors, and bins are being provided. It is probable that the tailings will also be roasted.

The new 300-ton mill of Geyser Marion Gold at Mercur has been started. Ore is to be mined by steam shovel. Values run about $3. Fifty men are employed. Glenn R. Bothwell is manager.

At the West Dip property near Mercur, a body of base ore carrying gold has been cut on the 700 level. Mark Requa is financing operations. Lawrence Requa is in charge.

A number of mines in the Tintic district are becoming active. At the Chief Consolidated's Apex Standard work has been resumed and sinking started. The Gemini, shut down for nine years, has been equipped with a new surface plant, the headframe rebuilt, and workings have been put in condition to the 1,000

level. Below this point, the shaft is being repaired. The Zuma is being cleaned up and retimbered. Tintic Gold is drifting on its 600 level.

Park City Consolidated is cutting a station on the 900 level preparatory to installing pumps capable of lifting 1,000 g.p.m. With these in service extensive development below water level of veins productive above will begin. Connection is to be made with the north drift of the Ontario No. 2 drain tunnel.

Park Utah Consolidated is deepening the drainage ditch of the tunnel and making repairs. New ore development has stimulated activity at the American Flag. Shipping ore containing gold, silver, lead, and zinc has been followed for 90 ft. below the 1,100 level in a winze.

Forty-five men are employed at the Annie Laurie near Marysvale in the mine and cyanide plant. Old workings have been reopened and new ore has been developed.

NEVADA

• Examination of an area 5 miles square in the Goldfield district, east of the productive belt, which has been made in the last six months by a party headed by Augustus Locke, is said to be for Calumet & Hecla.

Pardners Mines Corporation has dropped its option on the Dixie Valley mine, in Churchill County, owned by the Comstock Keystone, of Silver City. The latter continues to operate the mine and 30-ton mill.

In the Comstock district a base survey and mapping of the topography over a wide area have been in progress for two months by United States Geological Survey. When the maps are made a geologic survey will be started, chief attention to be directed to the western or footwall area as far west as the foot of the Geiger grade and the Valley fault. Geology of this western area has never been covered.

At Manhattan, the Natomas Company is employing three churn drills in developing water and prospecting a large placer area with dredging in view.

In the Como district, Stone Cabin Consolidated has provided an adequate mill-water supply from wells. The 300-ton flotation plant is to be enlarged to 500 tons, the present capacity of the recently built cyanide plant. Ore is mined in a glory hole. Burdette F. Grant has been made general superintendent.

Twenty feet of 2 per cent copper ore has been cut on the 600 level of Mountain City Copper at Mountain City, Elko County, Nev., owned by International Smelting. The development, regarded as interesting geologically, is not expected to increase reserves greatly. On the upper levels this orebody is estimated to contain 500,000 tons of ore. The 200, the 400, and the 500 level and raises have cut another orebody averaging 30 per cent copper.

Development on the 600 indicates that the company will find its high-grade body on the lower levels. However, inasmuch as the company already has more ore on the upper levels than it can ship on the present market, the work will probably be confined for the present to the 600 and levels above.

Seventy carloads of gold ore have been shipped in recent months from the Andesite property, at Modena, by W. F. Snyder & Sons to the Manning mill. Quartz veins in the Andesite carry 0.25 to 1 oz. gold per ton. The "Little" vein is being worked by a 350-ft. shaft. The "Big" vein is worked from the surface. Ore is also being mined in an open cut.

E. B. Young and W. J. Franklin have organized the Elkoro Mines Operating Company to operate the gold mines formerly worked at Jarbidge, by the Guggenheim interests. A 200-ton mill will be built.

MONTANA

• Mining camps of Montana display more activity than has been seen in years. The number of men at work can reasonably be placed at several thousand. Many of these are individuals engaged in leasing. Butte Highlands, south of Butte, is milling 50 tons of gold ore per day. The Anaconda company is granting leases to individuals for a period of one year. In Powell County, the Yuba company is working a portable dredge near Avon, and at Gold Creek the Gold Creek Mining Company and Yuba Engineers, Inc., are dredging about 6,000 cu.yd. per day. To the north of this point a dragline is to be installed by John H. Stratton and Milwaukee associates. Properties working at Philipsburg include the Trout, Moorlight, Silver Prince, and Little Bonanza. The mill of the Philipsburg Mining Company burned recently and is to be rebuilt. Twelve carloads of machinery have been shipped in at Virginia City by the Humphreys Gold Corporation to work the placer deposits in Alder Gulch. In Jefferson County, the Basin Montana Tunnel Company is working the Comet and Gray Eagle mines and is milling about 160 tons per day. The mill is to be enlarged and a new hoist is to be installed at the Comet. At Radersburg, the Keating mine has been taken over by Leo Coady and George Griswold, Jr., who will erect a new mill.

So far activity is negligible in the Neihart district, as there is considerable snow in the mountains. This is one of the principal silver districts in the State.

The Pohlman interests, of Spokane, are said to have purchased the Big Seven mine. Howard McLean, of Lewistown, has taken over the Old Kendall mine of the Barns-King company. A number of small properties are operating in the Little Snowy Mountains.

In Beaverhead County, the main activity is in the district west of Dillon, which includes the camp of Argenta and Bannack. The Thompson Gold Mining Company is operating its mine and mill on the old Bannack property. Other operations in the district include that of the Chipaul Mining Company on the Bob Hauska claim. The Mammoth Mining Company is operating the King Mine, situated near Twin Bridges, in Madison County.

Wallace, in the panhandle of northern Idaho, the administrative seat of Shoshone County, in the center of which is the famous Coeur d'Alene mining district. Shoshone County lies on the west side of the Continental Divide and is mountainous, having few level spots. Mining started here in 1879 and is still the major activity

New Mills Planned for Beebe Gold, Spring Hill and Others

Activity at California Camps Continues Pace, and Instances of the Application of Flotation Increase in Number—Carson Hill to Make Improvements—Gold Dredging Bill Reported Tabled

ERECTION of a new 400-ton mill at the Beebe mine is planned by the Beebe Gold, near Georgetown. The plant will be situated near the new shaft now being raised from the 500-ft. level in the Beebe mine, and will contain a 20x5-ft. Hardinge-Hadsel mill, two 7 ft. by 36-in. Hardinge ball mills, two 5x12-ft. Hardinge countercurrent classifiers, one 4x20-ft. Dorr classifier, and Kraut flotation equipment to treat the 65-mesh classifier overflow. Primary and secondary crushers will provide a ¾-in. ball-mill feed, and the mine-run ore, broken to pass a 12-in. grizzly, will be fed direct to and ground to 65 mesh in one operation in the Hardinge-Hadsel mill operating in closed circuit with a Hardinge classifier. Flotation concentrates are to be cyanided in a plant built for that purpose. Mining will continue during construction, the output being treated at the old mill.

Plans are maturing for erection of a mine surface plant and a 100-ton flotation mill at the Spring Hill mine, at Grass Valley. Equipment to be installed at the mine include ore bins, a headframe with a built-in crushing plant, compressors, and hoisting machinery. Construction of the mill building has started, and the plant is expected to be in operation by Sept. 1. The property is owned by Spring Hill Mines Company, controlled by San Francisco interests.

At the Chicago-Auburn mine, near Auburn, preparations are being made to enlarge the 35-ton mill to 100 tons, employing flotation, concentration, and pan amalgamation.

Exploration and development work is in progress at the Montezuma mine, operated by Montezuma-Apex, a subsidiary of Utah-Apex. The holdings of the company are near Nashville, about 12 miles south of Placerville. The main shaft at the Montezuma mine is nearing the 1,500-ft. level, and a new drift is to be started on the 1,300-ft. level. The 250-ton mill is treating over 200 tons of ore a day, mined from veins on the 1,200-ft. level.

Development of an orebody below the old workings of the Sliger mine, near Greenwood, has been confirmed by the management of Middle Fork Gold Mining Company, owners. Uncovered below a fault that cut off the vein formerly exploited, the vein is said to be 40 ft. wide and 200 ft. long, sampling nearly an ounce of gold per ton. A 100-ton flotation mill is on the property.

According to a report from Sonora, installation of a flotation plant has been completed at the Eagle Shawmut mine, at Chinese Camp, operated by A. W. Ellis, of Long Beach, and associates. Ore will be mined above the main tunnel level and from a small vein of rich ore discovered recently on the surface. Near by, a 100-ton cyanide plant for treating the old chlorination and mill tailings on the property, a separate project said to be sponsored by Southwestern Engineering Company, has been started up.

Carson Hill Gold will install a second power shovel in its open cut on the Calaveras vein. Underground operations are proceeding from the 200 to the 3,000-ft. level, with sufficient ore being broken to keep the mill at 1,000 tons' capacity. The company plans additional improvements to mill and cyanide plant.

W. W. Johnson Engineering Company, San Francisco, has completed a 5-cu.ft. gold-placer dredge on the Frank Collins holdings near Ione, for the Arroyo Seco Dredging Company. The dredge has a capacity of 150,000 cu.yd. a month, and maximum digging depth is 40 ft. A second unit designed by the company, involving an expenditure of $200,000, was launched recently at the Laird ranch, near Loomis, by the Gold Hill Dredging Company. Construction of this new unit was in the hands of the Moore Shipyards, of San Francisco.

Silver Lead Syndicate, Inc., J. J. Beeson, president, plans early reopening of its mines at Keeler. The concern has a lease on the Cerro Gordo mine, the Estelle mine, and La Depreciada mine, all lead-silver producers. The company was organized in Los Angeles in 1934 and maintains offices in the Scott Building, Salt Lake City, Utah. A production of $15,000,000 is credited to the Cerro Gordo mine.

The Desmond bill, A. B. 2168, designed to require gold-placer dredges to replace soil removed by dredging operations so that tailings are covered to a depth sufficient to permit farming operations, was tabled by the Committee on Agriculture.

The Palermo Dredging Company is conducting this operation near Oroville, Calif. The washing plant is supplied with gravel by a dragline. Power for the plant is supplied by a Caterpillar diesel, fuel costs averaging about 12c. per hour. About 50 gal. of 5c. fuel oil is required for a day's run of 20 to 23 hours

Iron Country Gold Mine To Be Examined

The Ropes gold mine, in the Ishpeming district, Michigan, which is being reopened by Calumet & Hecla Consolidated, is now unwatered, making it possible for the geologists and engineers to explore all of the workings and map out the development campaign. Lands to the west of the mine that are under option also will be explored. In the earliest days of its operation more than $670,000 in gold and silver was obtained from the Ropes.

NEWS FROM WASHINGTON

By Special Correspondent

NEW DEAL forces were completely routed by the most unexpected sweep of the Supreme Court rulings with respect to NRA, announced in the last Court session of May. But reorganization of the reform phalanxes was immediately undertaken and a new campaign of legislative procedure is being mapped.

Congress some time ago lost its rubber-stamp attitude toward legislation proposed to it by New Dealers. This makes doubly difficult enactment of labor legislation in conformity with the Supreme Court ruling. The motives and objectives of the New Deal are, however, wholly unchanged. Hence Congress will be asked to reestablish as much of the Federal regulatory machinery as can be re-designed in conformity with Court specifications. And some of this will surely be enacted.

The confusion resulting from the Supreme Court findings as to constitutionality will create several weeks of extra work for Congress. There is now no hope that the list of "must" bills can be quickly cared for. While the major leaders of the two Houses are busy formulating the new campaign, minor chieftains will be pressing their pet measures. The chance of enactment of much secondary legislation is, therefore, increased—provided only it is not in the debatable class proscribed by the Court.

Government Mining

DEFINITE PLANS for Government aid in actual operation of mines under the work-relief program advance slowly. No official announcements have yet been made at the time of writing (the last of May). Early in June, however, plans are expected to take shape with respect to some of these undertakings. The best opinion continues to indicate the development along the lines described in *E.&M.J.* last month (May issue, page 214).

The Pope bill (S.1476), requiring activity under direction of the Bureau of Mines to use $75,000,000 to $100,000,000 of the work-relief money, has not progressed. It appears unlikely that that measure will be needed, as the objective sought can so readily be accomplished by Presidential order, using work-relief funds either through the Bureau, or under other agency if preferred.

The bill (H.R.7675) proposing to establish a Board for Strategic Materials also remains dormant in the House committee. This so-called "tin bill" has come under fire from several angles, which fact makes even serious consideration appear improbable, unless unusually effective behind-the-scenes logrolling can be accomplished by its sponsors.

New Securities

GOLD-MINING SECURITIES continue to be the principal problem of difficulty of the Securities and Exchange Commission, in so far as mining and mineral security issues are concerned. Promoters naturally seek to have left in their prospectuses sufficiently glowing comment on new mine ventures to stir the imagination of the hoped-for purchaser. Without such enthusiasm-creating comment, the stock salesman, of course, finds security selling more than ordinarily difficult. And yet the S.E.C. engineers and attorneys are charged with the duty of eliminating unwarranted or deceptive material.

It has become a nice problem in sales psychology to determine how far S.E.C. must go in toning down suggested sales literature which is submitted for comment and approval. The Commission has undertaken to be generous in its allowance of puffing so long as there is no reasonable ground for assuming deception of the reader. But, the officials well recognize, even so there is no control over what the salesman tells his prospect orally.

Furthermore, officials of S.E.C. ruefully explain, there is apparently no legal ground for the Commission to hold up a security issue merely because the quantity of stock or the face value of the bonds to be offered appears too great for the property in question. If the property is honestly and accurately described in the statements filed and in the sales prospectus, there is nothing to prevent selling a million dollars' worth of stock on a hundred dollars' worth of property, assuming that the fact of the real value is clearly stated. And S.E.C. staff people are finding that even a good prospectus is not enough to protect the gullible investor from himself.

Change in negotiations at S.E.C. to insure greater speed in handling of new security listings is demanded. Furthermore, there is constant pressure to eliminate from the required filings some of the statements now specified by law or regulation. The S.E.C. officials point out, however, that generally the delays in permitting issues of securities come from the fact that the statements filed are inadequate, through the fault of the promoter himself. Under those circumstances, the Commission must by law hold up the issue until the regulations and law have been complied with.

Even engineering statements are frequently wholly inadequate, lacking maps or other interpretative or supporting data essential to intelligent understanding of the reports filed. Mining engineers making securities-issue reports for principals are, therefore, urged by the Commission to make sure that every detail pertinent to a critical review of their reports be included the first time. Ultimately they will have to be submitted, and omission originally merely causes delay.

One of the most severe criticisms ot the present S.E.C. practice is the requirement that a balance sheet be formulated when securities are to be issued for a mineral prospect which has not yet reached the status of a mine. Officials recognize that the formulation of such balance sheet is difficult if not impossible. Modified regulations may, therefore, somewhat change the detailed requirements in this particular. It is not expected, however, that there will be any change as to the requirement that estimates be submitted of prospective expenditures and costs. To be eliminated, therefore, are only the guesses hitherto required as to prospective recovery and anticipated income. Formulation of these intangibles into a balance sheet appears rather too fantastic, even though the original bureaucratic concept of those who drew the law clearly anticipated that such guesses would become a part of the record.

Mineral Economics

FOUR PHASES of the mineral economics work of the Government are to be strengthened, according to plans just being perfected for the work of the next fiscal year of the Bureau of Mines:

1. Enlarged statistical work on minerals for which annual summaries are presented in the "Minerals Yearbook," with addition of a number of experienced specialists to take charge of particular commodity inquiries.

2. An enlarged survey of scrap and secondary metal, with a view to building up information on the recycling of secondary metal as a factor in curtailed demand for primary supplies.

3. Forecasting of demand for mineral products—an entirely new undertaking.

4. International mineral movement investigation, with the objective of preparing flowsheets that will show graphically production, import and export, and consumption by countries of each of the metals and minerals having economic importance in the international trade of the United States.

Items 3 and 4 of this program rep-

resent fundamental fact-gathering studies from which it is anticipated a national mineral policy will be formulated. In the forecasting of demand, the Bureau will restrict its effort to statistical facts and their immediate implications, and undertake to avoid altogether the type of forecasting which has a tendency to become market-price manipulation. Certainly at the outset, only short-time forecasts will be undertaken, after the fashion of the quarterly estimates of prospective demand for gasoline on which much of the allotment-of-production quotas of the Petroleum Administrative Board have been based.

The work on international flow of mineral commodities is an outgrowth of studies for 1929 and 1932, now practically complete, made at the request of the War and Navy departments. Those studies related primarily to strategic metals and minerals with a view to determining how the United States would maintain its necessary industrial and military supplies of these commodities in the event that either the Atlantic or the Pacific were closed to free movement of our shipping. The industrial significance of the work has, however, come to overshadow the military implications and an extension on a broad scale to the commodities outside the range of so-called strategic materials is expected.

Natural Resources

ONLY the natural-resource industries seem likely to have comprehensive regulatory measures provided for them. These industries, according to proponents of these theories, are intrinsically of Federal concern because they have to do with protection of natural resources, a matter of great national importance.

Great effort will be made to formulate something approaching the comprehensive NRA programs for these industries. Most likely to succeed are the efforts on behalf of coal and petroleum; but some of the major metal and non-metallic mineral industries may also find favor among legislators. For all other manufacturing industry, the first judgment of Washingtonians is that the Supreme Court has ruled out all possibility of imposing wage and working-hour control.

Minerals Division Moves

THE Minerals Division of the Bureau of Foreign and Domestic Commerce has become a part of the Economics Branch of the Bureau of Mines in the Interior Department. This transfer was authorized in the appropriations bill passed early in May and approved by the President on May 9. Thus there is concentrated in one unit the economic and statistical research of the Government, both that relating to domestic production and that having to do with foreign trade.

There will be continued in the Bureau of Foreign and Domestic Commerce a new Division of Metals and Minerals, in which there will remain a section having to do with foreign trade opportunities with respect to these commodities. These trade promotion activities continue as heretofore in the Commerce Department. Only the fundamental economic and statistical studies are centralized in the Bureau of Mines.

Potash Institute

LATE in May announcement was made in Washington of the foundation of American Potash Institute, Inc., an agency to represent all the large American producers and the single large American importer of potash for the stimulation of scientific research. Dr. J. W. Turrentine, for many years chemical specialist of the Department of Agriculture, has been elected president and chairman of the board of the new organization. G. J. Callister, who for nearly 25 years has been connected with the educational work of the industry, is to be vice-president and secretary.

Headquarters of the Institute will be in Washington, D. C., from which point research and the preparation of educational literature will be directed. The Institute will, however, not establish any experimental laboratories of its own. The research work which it will finance will be done altogether in established institutions under State, Federal, or private management.

Combination Smelting

A NEW TYPE of double-barreled attack on metallurgical problems is being considered by what R. S. Dean, of the Bureau of Mines, chooses to call "combination smelting." The objective is economic success by merging two uneconomic efforts in a single metallurgical process. Although now at early stages of consideration, Mr. Dean explains that he believes there is some opportunity for practical development of this sort in the United States.

The example which he cites is the possibility—and he stresses that it is only a possibility as yet—of merging copper and manganese smelting in Montana. Chemically, it appears sound to proceed along the following lines: The two ores would be smelted together with the objective of producing a manganese-copper matte with a ferrous silicate slag, which latter would be discarded. Blowing of the matte would then give, at the second stage, blister copper and Mn_3O_4 as a synthetic ore. Economic success is, of course, problematical; but, as Mr. Dean explains, "It seems worth trying."

No plans of the Bureau have yet been formally arranged to undertake the combination smelting investigations, but it is hoped that some such experiments can be taken up in the next fiscal year.

Gold and Silver

PLANS are gradually being matured in Washington to facilitate Government aid in gold and silver mining and extensive prospecting by the idle who would be glad to undertake this on a grubstake basis. Initially, such work will probably be limited to Federal or State-owned lands. Too many legal complications arise as to the rights of the Government, and still more as to the rights of the prospector, when working elsewhere. Even on Government forest reserves and Government land open to mine claims there is legal question as to what the Government may retain in the way of ownership if a prospector or company wishes to secure a mineral claim. There is some thought, consequently, that all such mineral land will have to be withdrawn from entry if it is to be explored with Government aid under the work-relief program.

One proposal regarding precious metals is that prospectors and small business enterprises aided with work-relief money should be given the right of ownership to all the precious metals discovered as an inducement to extended activity. In such case, work relief would amount merely to grants-in-aid for the work, not as liens on the property or the production. Gold and silver produced would, of course, be sold to the Government, but under no different conditions than if mined without Government assistance. As yet no one seems to know whether, as a matter of policy or law, Uncle Sam can go quite that far.

Underground gossip in Washington continues to indicate plans for further silver price advance. Those usually well informed are now guessing that the next jump will be all the way to $1.29 per ounce. That, however, is just a guess. Probably the President and the Secretary of the Treasury, worried as they are with legislative problems, have not yet given any really serious consideration to this question. Early fall is, therefore, suggested as a most likely date for making the next silver price boost.

Talk about further devaluation of the dollar, by cutting 9c. more off the gold price to the minimum legal limit of 50c., has almost disappeared from the Washington gossip. Washington regarded the suggestion by Secretary Morgenthau in mid-May of international stabilization of exchange as merely a gesture. Undoubtedly the President and the Secretary of the Treasury are, as Morgenthau said, approachable on this subject; but it is doubtful whether they expect an approach from London or anywhere else. Certainly no program of a serious sort has yet been formulated at Washington on which to base an agreement likely to be acceptable in London, Paris, or other European capitals.

Power From Coolidge Dam Sought For Arizona Molybdenum

Crown King Dewatered Down to 100-Ft. Level—Bullion Gold Acquires Mardis Holdings in Castle District—Portland Plans Erection of Small Mill—Pilot Plant for Evahom

THE power line built by Mammoth-St. Anthony and Molybdenum Gold from Hayden to the mines at Mammoth has been completed. Power is now available for the 200-ton mill of Molybdenum Gold, which is to treat 100 tons per day from the Mammoth mine as well as the company's output from its New Year and Mohawk mines. A contract has been signed by Arizona Molybdenum Corporation for the purchase of power from the Government (Coolidge Dam). If the contract is approved in Washington, construction of a 12-mile branch from the Mammoth line will be started at once. Present operations are at the rate of 150 tons daily to a flotation mill for the production of a 97 per cent concentrate.

Monte Christo Gold Silver has progressed from the 600- to the 800-ft. level with the dewatering and retimbering of the shaft. A 50-ton mill is being operated on dump ore, trammed to a ball mill, ground, and floated in Fagergren cells. H. B. Browning is superintendent at Constellation.

Keystone, near Chloride, is producing a copper-iron flotation concentrate, containing the gold and silver values, for shipment to Torrance, Calif.

The Miami smelter of International Smelting completed its campaign, emptied the bins, cooled the furnaces, and is again storing Miami Copper concentrates.

Portland Mines will begin construction of a 50-ton mill under supervision of J. A. Potter, of Kingman. The mine, in the Katherine district, is held under bond and lease by a Texas group, which is headed by James Wood, of Dallas.

Morgan Mine is down 400 ft. on the 600-ft. shaft at Sells. The vein has been traced for 3,000 ft. on the surface; the shaft is reported to be in ore the entire depth. Milling equipment is available, but no adequate water supply has been found in the immediate vicinity. Tom Frazier is mine superintendent.

Crown King Consolidated has opened the mine to 100 ft. with 1,800 ft. of workings exposed. Dewatering will proceed to the 500. During recent months the 150-ton cyanide-flotation mill, surface equipment, and housing facilities have been built or reconditioned. The mine produced $1,500,000 from 1890 to 1901, and an estimated $500,000 by intermittent operation since that time. Present operations are directed by Victor L. Smith, president; W. W. Edwards, general manager; and C. O. Vowell, mine superintendent. Eagle Mining, H. R. Wells, manager, is sinking a shaft on the Saratoga, leased from Crown King. The Del Pasco property is under development by Lawrence DeZee, of Los Angeles.

The old Casterson, near Payson in the Tonto Basin, has been leased by Merrill and Moody, of Thatcher. Milling ore has been developed for a depth of 125 ft., the vein exposed for a length of 250 ft.

Bullion Gold Mining, a new corporation, has acquired the property of Mardis Mining, in the Castle district, 15 miles north and east of Wickenburg. Gold ore with a value of several million dollars is reported in a blanket deposit near the surface. E. L. Tomlinson has been engaged as engineer to build a road, set up a camp, and install necessary machinery.

Pioneer Gold reports successful operation of its mill at the Pilgrim mine, in Chloride. Earl F. Hastings, Jr., has been appointed general manager for the company. West Side Leasing, at Tombstone, has made the first run in a 45-ton ball mill and table concentrator, under A. M. Bell. Southwestern Metal Mines has secured an RFC loan to finance dewatering of the French Lily, at Cleator. The ore is said to be zinc carrying over an ounce of gold per ton.

A 10-ton pilot plant has started treating ore from the Evahom mine, formerly called the Woodchopper, in the Mineral Park district, near Chloride. The old Gunsight, 16 miles east of Ajo, a silver producer in the 70's and 80's, has been acquired by J. D. Mitchell, of Chandler. A crosscut will be run from the bottom of the 400-ft. shaft to the Silver Girt and Eastern veins.

Natural-Gas Supply Proposed For Iron Country

Lake Ore Movement Under Way—Objections Made to Occupation Tax Levy

IRON ORE is moving down the lakes in good volume. The operators on the western end of the Mesabi range were busy during the first part of the month tuning up the washing plants and checking this season's operations with last after making estimated improvements. The new St. Paul mine plant, at Keewatin, is now in full production and claims to be getting excellent results with the new Hydrotator machine. This mine is also busy pumping mud from the Prindle property, next door, by using a system of three pumps located every hundred feet along the discharge line. It is found that the heavy mixture moves better by using this combination and a small-diameter pipe than by trying to force it with one pump of a higher head and larger discharge.

A new plan for reducing the cost of producing sinter from low-grade ores is being presented to the operators and also officials of the various range cities by Montana gas well owners. By running a 20-in. diameter pipe line from the Montana gas fields to Minnesota cities and iron ranges, the gas can be sold for 18c. per 1,000 cu.ft. for 1000 B.t.u. gas compared to the present price of over one dollar for the same amount of 550 B.t.u. gas. This is based on borrowing $25,000,000 from Washington at 4 per cent for fifteen years to pay for the line, the money to come from the four billion dollar fund. Building the line would require 1,000 men for the summer through Minnesota and an equal number through the Dakotas. With a price of 18c., 5c. would go to buy gas in Montana and the 13c. is sufficient, according to estimate, to deliver the gas in Minnesota and care for the loan. This price for gas is the same as for coal of equal heating value at $2.60 per ton. If such a proposal proves feasible it will mean a tremendous saving to the people of Minnesota, not only for heat and power but to assist in producing merchantable sinter from the billions of tons of low-grade ore.

Eight mining companies objected to their share of the $1,235,578 occupation tax on iron ore, specified by the Minnesota Tax Commission for 1934, at a hearing May 20. The main objection was to the method used by the commission for computing deductions for depreciation, royalties, operating expense, and valuation of plants and equipment, which the mining companies claim should should be deducted due to non-use. Some changes may be conceded by the commission, but it is likely the total amount will vary little from the first amount set.

Canada's Precious-Metal Mining Proceeds at Healthy Pace

Remarkable Activities in Three Major Provinces Command the Attention—Gold Boom on North Shore of Lake Athabaska—Miners in Bridge River District of British Columbia Strike for Higher Pay

LAKE ATHABASKA is the scene of the latest gold boom in northern Canada. One hundred and fifty miles long, it lies astride the boundary between Alberta and the northwestern extremity of Saskatchewan. The gold finds are on the eastern part of the north shore, within Saskatchewan, so claims are recorded at Regina, 650 miles south.

The first find was made on Beaverlodge Point last fall by prospectors in the employ of Consolidated Mining & Smelting. During the past winter two diamond drills have been at work on this property. No announcement has been made as to the results. W. G. Jewitt is directing exploration for the company in this area. A number of substantial companies and syndicates have staked extensive holdings round the discovery group, including several of the companies operating at Great Bear Lake, some Toronto mining groups, and Edmonton syndicates. Great Bear Lake Mines have had a diamond drill at work since March and have reported numerous high-grade intersections. Most of the visible gold found so far is in veins and veinlets of quartz in mineralized porphyry, intruding Pre-Cambrian sediments. Several geological parties will be employed during the summer in mapping the area.

The north shore of the lake is readily reached either by air or by water. During the past winter all equipment and supplies, as well as staking parties, were flown in from the end of steel at McMurray. The flying time is two to three hours. There is also an air base at Edmonton, two hours farther south. The distance by water is 300 to 350 miles. Substantial river and lake craft are available for regular trips to the new gold area.

ONTARIO

• A much enlarged program for the Geological Survey of Canada has been announced at Ottawa. Geological parties 180 in number are to take the field across the Dominion, and the larger part of these will search out and map in detail areas favorable to the occurrence of gold. The expenditure this year of almost four times the amount spent during recent years on such field investigations marks two notable facts —namely, that the present day prospectors make much practical use of the information furnished by these geological maps and reports, and that gold production is now playing a leading part in Canada's internal and external economy. The Canadian people, until recently only vaguely conscious of the prime importance of the country's mineral output, are now sufficiently alive to the facts to support a much enlarged expenditure on geological mapping at a time when most other government expenditures are being curtailed.

Central Patricia's mill addition, which brings the capacity to 100 tons, is now running. McKenzie Red Lake's new 150-ton mill is treating ore running ⅓ oz., the mine average being 0.437 oz. and the operating cost $6. Pickle Crow's 125-ton mill is now in operation, the mine average being about 1 oz. These three new mines in the District of Patricia are in contrast to the pioneer of the district, Howey, which continues to make a profit in its 1,100-ton mill from ore yielding 0.09 oz. per ton.

The Macassa mine, at Kirkland Lake, is rapidly increasing its ore reserve toward the point where an enlargement of its 200-ton mill will be warranted. During the present year the recovery per ton has been stepped up from $11.89 in January to $16.39 in April. New ore has been indicated by drilling on the 2,475-ft. level at a point considerably west of any ore formerly known, and this is now being opened by drifting.

Buffalo-Ankerite has increased its mill capacity to 500 tons. The recovery for the first quarter of the year averaged $6.82 per ton, and a 20 per cent annual dividend is being maintained.

An all-round expansion of Falconbridge Nickel's operations will be possible after the completion of the new 1,500-ft. central shaft in June. Meantime, the east orebody is being opened down to 500 ft. and diamond drilling is being carried on below that level in what is practically an unexplored section of the ore zone.

The Canadian Reserve mine, at Larder Lake, between Kirkland Lake and Rouyn, has been taken over by Castle-Trethewey, which will remodel the 200-ton mill, probably to treat 300 tons.

The old saying that the best place to find a new mine is in an old camp has some force at present in Porcupine. The latest of the numerous revivals here is Pamour Porcupine Mines, whose property was formerly divided among Three Nations, La Palme, and Porcupine Grande. During recent months Quebec Gold Mining Corporation has done a substantial amount of exploration on a gold-bearing zone that promises, from diamond-drilling results, to yield an important volume of ore. Noranda has now optioned control.

The 25-ton mill of the Dik-Dik mine, east of Lake Nipigon, has been put in operation. Openings to 150 ft. have shown that there is a substantial amount of the high-grade ore (about 2 oz.) that showed on the outcrop, and beyond this there is ore of moderate grade. J. B. McMartin, of Montreal, has acquired the mine from Alderson & MacKay.

The 50-ton mill of Tashota Gold Mines east of Lake Nipigon is now in operation. Discovered fifteen years ago and developed intermittently, the mine has been brought into production by Minefinders, Ltd., of Toronto, of which J. C. Rogers is president and John A. Lindsay vice-president.

QUEBEC

• Noranda has completed pilot raises from the 1,250-ft. level to the surface and will continue them to 3,000 ft. for what will ultimately be the new No. 5 shaft, according to a statement made by J. Y. Murdoch at the recent annual meeting. The company will maintain its gold production of last year, and this may entail a slightly increased copper production, since some of the ore high in gold in the lower levels has an increased content of copper. Last year the company produced selenium for the first time at its refinery in Montreal. Preparations for the company's 25,000-hp. power development on the Upper Ottawa River will be completed by the end of the year. Mr. Murdoch pointed out that in 1933 the taxes paid by Noranda amounted to 59c. per ton of ore mined and that this had risen in 1934 to 70c.

With eight years' supply of ore for the present 1,100-ton mill in sight, and its deposits opened to a maximum of only 1,000 ft., Beattie Gold Mines is in a splendid position to expand its mill. But the ore is so extremely refractory that it is still necessary to ship concentrate abroad for treatment, so an enlarged output must await a more economical method of treatment.

The Aldermac copper-sulphur mine, in the Rouyn area, is to have the first plant in Canada for the production of elemental sulphur from pyrites, using the process evolved recently by the Rio Tinto metallurgical staff, the rights to which for Canada and Newfoundland have been acquired by Aldermac Mines, Ltd. The process involves the conversion of iron sulphide to iron chloride and sulphur by means of chlorine, and the oxidation of the iron chloride to release the chlorine for re-use. Thus a high-grade iron ore is produced in addition to sulphur. A test plant is to be erected by Aldermac's metallurgical associate at Niagara Falls, following which a plant will be erected at the

mine capable of producing 100 tons of sulphur a year. This will involve treating 500 tons of ore daily, which is the capacity of the present flotation plant. Recent mine development has disclosed a substantial tonnage of new ore running 3 per cent copper, which is well above the average of the mine.

BRITISH COLUMBIA

• Production from the Bridge River district has stopped because of a strike by the miners for a wage increase. They ask an increase of a dollar a day above the established scale at the Pioneer, which was $4.75 for miners and $4 for muckers. At the Bralorne miners were paid $5 and muckers $4. The companies concerned offered to compromise by raising miners' pay to $5.25 and the wage for muckers to $4.50, but this was not accepted by the strikers. Meanwhile, the Provincial Government is intervening, and it is hoped that by the time these notes appear in print a settlement will have been effected. The wage of $5 for miners at the Bralorne was higher than that paid to gold miners in Ontario. Immediately prior to the strike a crosscut from the main vein on the eighth level of the Pioneer had intersected the footwall vein, and values of 2 oz. of gold across 5 ft. were unofficially reported. Developments at the Bralorne at depth were also approaching a most interesting stage. Last month 11,876 tons of ore was treated at the Bralorne and yielded 3,850 oz. gold. As a result of the developments of the Ida May vein on the Bradian, the outlook for the property is becoming increasingly auspicious, and erection of a mill is likely. At the Minto milling capacity has been increased to 75 tons per day and satisfactory financial arrangements have been made for further development of the Congress and Senator properties. Negotiations also are in progress for financing the Olympic to permit exploration on a larger scale.

Gold recovery at the Cariboo Gold Quartz mine in April was 1,610 oz., valued at approximately $42,200; comparable with 1,353 oz. recovered in March. The recent annual report states that net profit after depreciation, depletion, and taxes was $30,206.89, compared with $2,541 in the previous year. Ore reserves as at Jan. 31 amounted to 99,674 tons, against 29,800 tons a year previously. A total of 28,722 tons was treated, with a heads assay of 0.405 oz. gold, and the recovery was 94.2 per cent. The report refers to very substantial and gratifying increase shown in ore reserves, and predicts further increases with substantially less development expenditures. The mill is to be stepped up to 200 tons a day, and the operators expect that by August 150 tons a day will be handled. Operating costs have shown a steady decline.

Island Mountain production in April was 1,130 oz. of gold, valued at approximately $34,000, from 1,800 tons of ore treated. The mill was closed four days in the month owing to damage to the power house, caused by a slide.

B. C. Nickel Mines has located two new orebodies. Channel sampling of one in the 3,400-ft. crosscut indicates 75 ft. of ore averaging 1.3 per cent nickel. Diamond-drill hole 118, directed due north from No. 1 tunnel at 4,025 ft., passed through areas of light to fair mineralization, and at 197 ft. crossed a 25-ft. section of ore averaging 1.9 per cent nickel. Three diamond drills running three shifts are making a footage of about 300 ft. per day.

Work on the 50-ton mill for Morning Star mine, in the Fairview camp, is proceeding steadily. The site has been cleared, lumber is being delivered, and milling machinery has been ordered. It is reported that Medco company is advancing the funds for mill construction and for the necessary working capital.

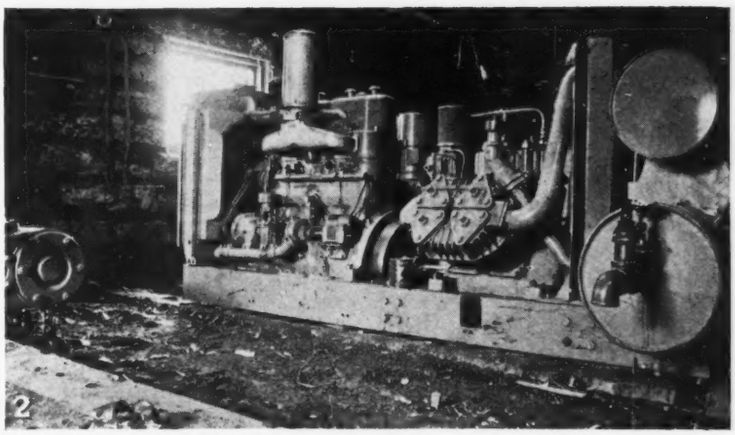
Dentonia Mines, Ltd., in the Greenwood division, reports its April production of concentrates at $32,000 from 2,900 dry tons milled. Gold recovery amounted to 922 oz. and silver 6,409 oz. Millheads for the month averaged 0.33 oz. gold.

Work has been started on a 50-ton flotation mill for the Morning Star (Fairview) Gold Mines, Ltd. Ore available for milling above the first level is estimated at 40,000 tons.

The Ymir-Sheep Creek camp this month adds the Sheep Creek Gold Mines, Ltd., to its list of producing mines. At the recent annual meeting, it was stated that the new mill should treat from 135 to 150 tons daily, and an estimate of mill feed values was given as 0.40 oz. gold. Known ore reserves were reported as being about 50,000 tons. Reno Gold Mines, Ltd., has opened four new levels below No. 5, each picking up the orebody. On the seventh level

At Chibougamou, in Northern Quebec

1. Camp of Consolidated Chibougamou Goldfields on Lac Doré. A large area including the original discoveries on this lake and Lake Chibougamou has been acquired from this company by Consolidated Mining & Smelting Company of Canada, which has flown in mine plant equipment (by Canadian Airways Limited) from Oskalaneo, on the railway 150 miles away, to this point. Two large planes were used. 2. This 250-cu.ft. Canadian Ingersoll-Rand portable compressor driven by a Hesselman oil engine is seen assembled at Lac Doré after having been brought in by air



drifting has added 300 ft. to the known length of the oreshoots. April recovery was reported worth $62,008. The mill rate is maintained at 100 tons daily. Kootenay Belle Gold Mines, Ltd., reports that the mill is crushing 50 tons daily, with millheads averaging about 0.40 oz. gold. Net smelter returns in the fiscal year ended Feb. 28, 1935, amounted to $61,811 from 2,114.36 oz. gold and 947.51 oz. silver produced.

Sheep Creek Gold Mines' cyanide mill went into operation on May 12, approximately one year after the present company acquired control of the property, which consists of the old Queen mine and some adjoining claims in the Sheep Creek district. The mill is initially handling about 100 tons a day, but will soon be operating at its nominal capacity of 150 tons daily. The ore treated is expected to average 0.5 oz. gold to the ton.

At the Kootenay Belle, the Hadsel mill started late in November, and to the end of the fiscal year had treated 2,413.6 tons of ore, producing 87.8 tons concentrates, containing 779.59 oz. gold and 277.63 oz. silver. It is operating efficiently, handling 50 tons per day. Average mill heads are 0.40 oz. gold, and the recovery by flotation is 94½ per cent.

Immediate reopening of the McAllister mine, near Three Forks, in the Slocan Mining Division, has been announced. The property is controlled by the Standard Silver Lead Mining Company through an operating company, the Slocan Silver Mines, Ltd. The company reports 10,000 tons of silver ore blocked out at the McAllister, and the property and plant in condition to resume shipments of crude ore to the Trail smelter. It is thought the mine can be operated profitably with silver at 50c. or over an ounce.

During April the Meridian mine, in the Lardeau Mining Division, milled 3,018 tons of ore, from which was produced 80.6 dry tons of concentrate, assaying 6.16 oz. gold per ton. The mill-feed averaged 0.169 oz. gold.

MANITOBA

• Flin Flon, which is a party to the copper-restriction agreement, will select ore with this end in view but will not curtail its total production of metals, according to an announcement by R. H. Channing at the annual meeting.

The steady progress of San Antonio is marked by the fact that its mill is now treating over 300 tons a day, that the average recovery has advanced to about $14 in spite of using a high proportion of ore from development faces, and that the reserve is mounting steadily in quantity and grade. With the 1,000-ft. level now accessible through the new central shaft, a rapid enlargement of the mine and subsequently of the mill is in view.

Tanganyika Gold in Public Eye—New Records on Rand

London Correspondence

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ROAN ANTELOPE Copper's report for the quarter ended March 31 shows an operating profit, after all London and administration expenses, of £128,664, which was reduced to £68,241 by deductions of £22,923 for debenture interest and £37,500 for depreciation. The price of standard copper averaged only £27 19s. 5d. per long ton during the quarter. Analysis of the financial statement indicates that production for the quarter was about 16,225 long tons of copper, costing £20 per ton before and £23 15s. 9d. after interest and depreciation. Taking exchange at $4.84, these figures come to 4.321c. and 5.095c. respectively per pound. The final profit of £68,241 is subject to taxation. It appears that cost of production was 2s. 6d. lower per ton of blister copper in the March than in the December quarter. Under the restriction agreement Roan Antelope's production will be reduced to 4,800 long tons in May and to 4,200 long tons in June and thereafter. With the smaller production, however, the higher price now prevailing for copper should give the company nearly double the amount of final net profit per quarter.

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Under the recently concluded restriction of copper production agreement Mufulira Copper Mines, Ltd., will produce 2,331 long tons per month from June 1, 1935, to Dec. 31, 1936; 2,900 tons monthly thereafter till Sept. 30, 1937; and from the latter date till June 30, 1938, 3,466 tons a month. This arrangement is "subject to alteration from time to time," dependent presumably on the volume of world demand for copper.

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Robinson Deep's fully developed ore reserve is estimated as 5,846,000 tons averaging 4.9 dwt. over 57 in. average width, W. A. Mackenzie said at the annual meeting. The pay limit of value has been reduced from 3.7 to 3.3 dwt. Of last year's development results he said that 60.9 per cent of the footage opened was payable, averaging 6.4 dwt. over 51.9 in. Mr. Mackenzie said the company would have to pay more taxation this year, that "the system of taxation of mining profits was quite unsound in principle and, from the shareholders' view, altogether too great an exaction."

Delayed arrival of materials will prevent the completion of the extension in July of Simmer and Jack's crushing plant. Several companies are voicing this complaint, the mining machinery manufacturers being overburdened with orders.

Vogelstruisbult's No. 1 shaft cut the main reef early in April at a depth of 3,670 ft. Value disclosed was 3.9 dwt. over 28 in.

Four new high records were set up by the gold mines of the Transvaal in March. They were: Total revenue, £6,336,029; working costs, £3,495,137; working profit, £2,840,892, and 3,604,500 tons of ore milled. The average grade of all ore treated was down to 4.749 dwt. from 4.911 dwt. in February.

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Trepca Mines, Ltd., reports that in exploring its Mazic area two small but encouraging orebodies have been intersected near a tuff contact. They total some 100 square metres in area and assay 8.8 per cent lead, 7.4 per cent zinc, and 5.8 oz. of silver per ton. This is the third of the seven or eight areas showing extensive ancient mining activities to be investigated in Trepca's concession. The first revealed the Stantrg orebody, which is certain to yield well in excess of 5,000,000 tons; the second, Meljenica, did not contain a large deposit at the point expected, so further exploration of it has been deferred. Of the lead-zinc-silver properties opened up in recent years, Trepca is the outstanding success. On the lowest prices recorded for these metals during the past few years the company has been earning profits of over $1,000,000 annually, subject only to depreciation and taxation, and paying regular dividends. Its rate of profits has probably been more than doubled by the recent advances in the prices of the metals it produces. Trepca's annual production of concentrates contains about 51,000 metric tons of lead, 47,500 metric tons of zinc, and 1,500,000 oz. of silver. There is astonishingly little variation in the tonnage milled, from 50,000 tons monthly, such as there is usually, depending on the number of working days in the month.

Speaking of the satisfactory results obtained by Trepca, A. Chester Beatty said at the recent annual meeting of Selection Trust, Ltd.: "We also have substantial holdings in other promising lead-zinc-silver propositions in Yugoslavia, which have already developed substantial quantities of lead-zinc-silver ore." This referred to the Kopaonik, Novo Brdo, and Zletovo companies, in which Union Corporation and Central Mining & Investment are also interested.

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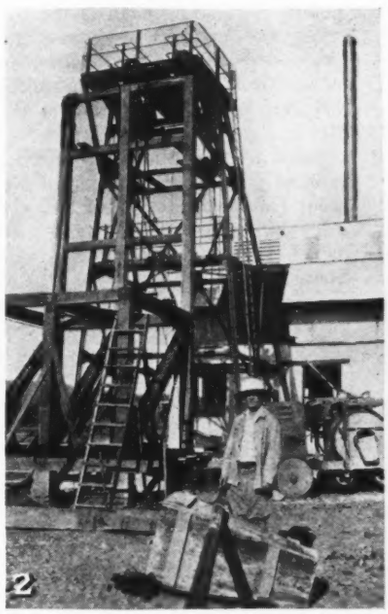
Gold discoveries and developments in Tanganyika Territory are constantly attracting increased attention. A number of groups are reported sending engineers there to investigate, the latest of these being National Mining. The developments being made by Kentan Gold

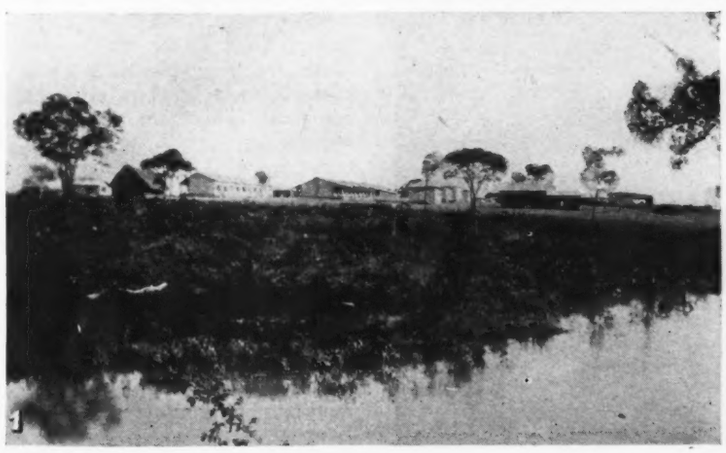
Areas, Ltd., in its Sanza Concession, just south of Lake Victoria, are judged by some to indicate the existence there of a gold area of first class importance. One of the several reefs was cut recently by an adit at a depth of 350 ft. and found to average 16½ dwt. over a width of 54 in. In another, called the Comet Star mine, a drift has been driven 60 ft.. in ore also averaging 16½ dwt., and the face was in 39-dwt. material when last reported. Promising gold discoveries have also been made at numerous other points in the territory, and a great deal of development work is being done by Kentan Gold Areas, East African Goldfields, and several other companies.

Selection Trust, Ltd., has been granted a concession for 40 years over an area of about 1,442 sq. mi. comprising the Ivalo district, in Finland. The district is described as an immense alluvial deposit from which gold has been recovered intermittently for the past 80 years, though it seems that no comprehensive test has ever been made of the values and yardage.

The East African Goldfields Enterprise

1. The camp in the Lupa district, Tanganyika Territory. It has housing facilities for 50 Europeans, warehouses and offices, including those for assaying and diamond drill work. Construction was started April 16, 1934, and completed Jan. 1, 1935. All buildings are of Kimberly brick, and have concrete floors, Celotex ceilings, corrugated roofing and extra large windows, all screened. Room partitions are of brick and carried to the roof. Termite-proof construction is used. 2. Headframe of No. 1 shaft. This is now 200 ft. deep and is to reach 500 ft. in 1935. The hoist is good for 1,500 ft. A. C. Brinker, manager, in the foreground. 3. Laying 3½-mile pipe line from water-supply well to power plant at camp, in the distance





Bendigo Again Yields Dividends

Work at Yellowdine Find Continues

Australian Correspondence

THE DUMP of Golden Horse Shoe (New), Ltd., now contains less than 500,000 tons, 2,000,000 having been treated since February, 1930, for gold valued at £500,000. Treatment costs are 2s. per ton. The company is investigating the treatment of other dumps.

Central Norseman Gold Corporation, N. L., is being formed by Western Mining Corporation, Ltd., to develop and equip the Phoenix mine, at Norseman, W. A. This is the first company to be formed by Western Mining Corporation. Options are held by the latter over many properties.

Triton Gold Mines, Ltd., formed to develop and equip the Reedys mine, at Cue, W. A., is to increase capital by £80,000 to £480,000 in 10s. shares. The main oreshoot on the 300 ft. level is 800 ft. long, 10 ft. wide, and assays 9 dwt. The mine is to be opened up to permit ore being mined on one shift instead of two. A cyanide plant (initial capacity 5,000 tons monthly) is being installed and will be in operation by August.

Milling operations at the Lancefield mine have commenced but no clean-up results are available. Certain sections of the plant, in which a considerable amount of old and new equipment is combined, are giving trouble. The plant is expected to treat 10,000 tons of 8 dwt. ore monthly. Ore reserves exceed 300,000 tons assaying 8 dwt.

Work on the new Yellowdine find, 25 miles east of Southern Cross, is being continued, but no very important developments have been reported. The original Palmers find, now being proved by Commonwealth Mining & Finance, Ltd., holds out most promise. On this section at least 30,000 tons assaying 2 oz. fine gold per ton exists. Shaft sinking and diamond drilling are now in progress.

Western Australia's gold yield for February was seriously affected by the strike, the output being 21,276 fine ounces or 31,318 oz. less than in January. It is now doubtful if the output in 1934—namely, 651,338 oz.—will be exceeded this year.

Marvel Loch Gold Development, N. L., a company holding a large area about 25 miles south of Southern Cross, W.A., has decided to install a treatment plant with a capacity of 4,000 tons monthly. Shaft sinking has disclosed payable ore over a length of 1,000 ft., with widths from 4 to 50 ft. More than 100,000 tons have been developed.

The North Kalgurli company is to

treat 6,000 tons monthly at the Boulder Perseverance mill, an increase of 1,500 tons. The ore reserves of the North Kalgurli property have been steadily increasing and at the end of the last financial year stood at 471,475 tons assaying 9 dwt.

Ora Banda United Mines, Ltd., has been formed in London by B.A.N.Z. Mines, Ltd., to take over the Mopoke and Slippery Gimlet leases at Ora Banda, W.A. The capital is £400,000 in 5s. shares, of which 700,000 shares were offered for public subscription, 400,000 shares were given to the vendors, and 500,000 shares are in reserve. Reserves are estimated at 161,400 tons, but large additions can reasonably be expected. A plant to handle 7,500 tons monthly is to be installed. The tailings dump contains 150,000 tons assaying 2½ dwt.

The Premier Gold Mining Company, Canada, is engaged in testing the Big Bell mine, at Cue. This is known to be a low-grade property, but if a sufficiently large tonnage of 4 dwt. material can be proved, large-scale operations can be carried on profitably. A new three-compartment shaft is to be sunk and a sampling crushing plant erected.

Little 180, the second Bendigo company to commence dividend payments since the present revival, made a net profit of £6,507 for the six months ended Jan. 31. The battery treated 4,937 tons for 1,424 oz., an average of 5.8 dwt.

Langi Logan Deep Leads, Ltd., has been formed by Australian Machinery & Investment Corporation, headed by Claude de Bernales, to work the Langi Logan deep lead system at Ararat, Vic. The area is of 6,120 acres, containing 16 miles of deep leads. The capital is £500,000 in shares of 5s. each. A second company of the same capital, Beaufort Cathcart and Moyston Leads, Ltd., has been formed to work deep leads at Beaufort, Cathcart, and Moyston, Vic.

Mount Bischoff Company, Tasmania, is engaged in prospecting to the south of the Waratah-Corinna road and adjacent to the Wilson and Harmon rivers. The creeks tested show tin oxide.

New Guinea Goldfields, Ltd., reports a net profit of £180,091 for the twelve months ended Sept. 30, 1934, after providing £29,231 for depreciation. For the period 35,103 tons of soft manganiferous ore were treated at the Golden Ridges mill on the Lower Area, for a recovery of 25,790 fine oz. The alluvial workings yielded 9,753 fine oz. and 5,049 fine oz. was won by tributors. A twenty-head battery and cyanide plant, with a capacity of 100 tons daily, is now being installed on the Upper Area, where the Edie No. 1, No. 2 and Karuka veins have been proved to contain 156,000 tons assaying 10 dwt. to shallow depth.

Capacity of the cyanide treatment plant of Golden Dyke Gold Mine, N.L., Northern Territory, is to be increased to 50 tons daily.

Higher Silver Price in Mexico Stimulates Exploration

New Discoveries Reported in Zacatecas—Government Adds Some Mineral Lands to National Reserve—Companies Protest Increase in Production Taxes—Dry Drilling Becomes Illegal

INCREASED ACTIVITIES in several regions, raising of wages, government action to settle strikes, requests for permission to shut down because of unprofitable operation, and protests against taxes featured late spring events in the mining industry of the various provinces of Mexico.

Conferences are being held in Mexico City between representatives of Amparo and Piedra Bola Mining companies and their workers who are on strike, and Luis L. Rodriguez, private secretary of President Cardenas, who has been selected arbiter of the conflict which affects several mines at Etzatlan, Jalisco. . . . Asserting that its operating losses from November, 1933, to April 30 were 60,117 pesos (about $19,000), Cia Minera y Fundidora, S.A., through its president, George P. Stoker, asks federal sanction to suspend work for four months at its holdings in Mazapil municipality, Zacatecas.

Potosi Mining Company has established minimum daily wages of 4.25 pesos for underground workers and 3.50 pesos for surface workers. . . . Mining companies in Guanajuato have fixed a minimum daily wage of 2 pesos for all workers.

The Golden Girl Mining, operating in Nayarit, has increased its working personnel from 300 to 1,000. . . . Many prospectors are working a rich placer deposit recently discovered near the Sombrero Motado mine, Mazapil municipality, Zacatecas.

The Cerro de la Bufa, overlooking the Chapatuato mining camp, in the State of Michoacán

Illegal operations, such as claim jumping and working deposits held under concession without the concessionaire's knowledge and consent, practices which have become common since silver prices began soaring, are being severely punished.

Cia. Minera y Beneficiadora Zacatecana de Oro y Plata, S.A., is installing a mill at Tres Marias, Santa Rita municipality, Zacatecas. . . . Daily metric tonnage production of Mexico's three largest smelters is given as follows by the Ministry of National Economy: Fresnillo, Zacatecas: 4,000; Parral, Chihuahua: 1,500, and Urias, Sinaloa: 50.

Monterrey (Nuevo Leon) Chamber of Commerce has asked President Cardenas to reconsider his recent decree which increases production taxes on metals, contending that as the northern states are at present producing low-grade ores, higher production imposts make this work unprofitable and threaten the closing of many north Mexican mines.

Sonora Consolidated Mining has granted workers earning from 2 to 2.50 pesos (about 56c. to 70c.) a day a daily wage increase of half a peso (14c.) at its El Tigre de Oro mine, Magdalena, Sonora.

Durango had approximately 3,000 mines in operation on May 1, the Ministry of National Economy announces.

Dry drilling is forbidden in mines throughout Mexico, and companies that continue this procedure will be severely punished, the Public Health Department has advised mining enterprises. Dry drilling causes such diseases as silicosis among miners, the department ascertained. Drilling is by wet methods only.

President Cardenas has ordered the incorporation into the national reserves of the Guelachinayaga Shidadahui Guelavegne tract, along the Laguna Superior, Tehuantepec municipality, Vera Cruz, for the explained purpose of increasing the federal government's silver resources. This tract contains much silver ore.

A loan of 1,000,000 pesos (approximately $280,000, U. S.) to finance working the 50 mines it controls, has been solicited of the federal government by the Alianza de Mineros y Explotadores Nacionales, S.C.L., a miners' cooperative unit.

Discovery of important gold, silver, copper, and lead deposits in the Tetela and Zacapoaxtla regions, Zacatecas, is reported by the Ministry of National Economy.

PERSONAL ITEMS

A Research Fellowship in ore dressing or metallurgy is open at the Missouri School of Mines and Metallurgy, Rolla, Mo., in cooperation with the United States Bureau of Mines. The candidate must have obtained his master's degree and be prepared to pursue work for a doctorate. He must present an acceptable problem. The stipend is $800 for ten months.

Charles Hardy returned to New York from Europe on May 16.

C. L. Hershman is in charge of the Buffalo-Ankerite mine, in the Porcupine district, Ontario.

H. C. Milton has been named acting chief mining engineer of Southern Rhodesia.

W. A. Mackenzie has been appointed president of the Transvaal Chamber of Mines.

P. K. Horner is in Siam, having arrived there from London via the United States.

F. W. Dryden has been engaged as superintendent of the Johnson mine at Octave, Ariz.

Charles Ordway, of Chicago, is in Ontario, Canada, where he will spend several weeks.

H. F. Filsinger has joined the staff of the Mina de Piramide at San Jose de Garcia, Sinaloa.

C. E. Rhodes is with the Cia. Minera Chontalpan y Anexas, S. A., at Taxco, Guerrero, Mexico.

Rudolf Gahl recently sailed from San Francisco for the Santo Domingo mine, at Tirapata, Peru.

E. J. Martin has been appointed mine superintendent for Falconbridge Nickel Mines, at Sudbury, Ontario.

Herbert R. Nye has assumed his new duties as superintendent of the Smuggler-Union mine, at Telluride, Colo.

James Y. Murdoch, president of Noranda Mines, Ltd., has been elected president, also, of Pamour Porcupine Mines.

A. B. Parsons, secretary of the A.I. M.E., has been elected to membership in the Institution of Mining and Metallurgy.

Henry P. Ehrlinger is now assistant manager of the New Mexico division of the Peru Mining Company at Deming, N. M.

L. L. Farnham, formerly with Oriental Gold Star, is now manager for Liberty Hills Gold Mining, Congress Junction, Ariz.

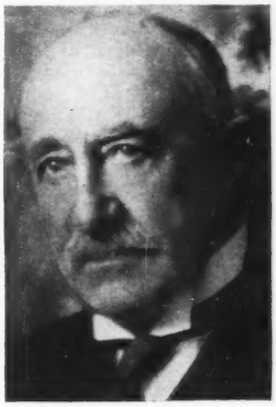
William A. Blomstran has joined the staff of Chateaugay Ore & Iron Company, at Lyon Mountain, N. Y., as assistant engineer.

Former President Herbert Hoover has been awarded an honorary degree of doctor of engineering by the Colorado School of Mines.

Richard Erion has joined the staff of Compania Minera Agua Fria, in Honduras, making the trip from Los Angeles by airplane.

O. J. Tuschka, former chief chemist with Old Dominion, is chemist for Demonstration Gold Mining, Baguio, Philippine Islands.

John Hays Hammond was the guest of honor at a dinner given by the Boys' Clubs of America, Inc., of which he is vice-president, at the Hotel Commodore in New York City, on May 22. The program included entertainment by six



John Hays Hammond

Boys' Clubs from the metropolitan district. **Charles Hayden** was chairman and **William Edwin Hall** toastmaster. **Charles M. Schwab** presented a medal to Mr. Hammond. **Lewis E. Lawes** and **George E. Vincent** made addresses.

W. W. Bradley, State Mineralogist, State Bureau of Mines, has returned to San Francisco from a business trip to Washington, D. C.

The Hon. Paul Leduc, Minister of Mines for Ontario, will make his first tour of the mineral regions of the province this month.

W. S. Dyer has resigned from the geological staff of the Ontario Department of Mines to join the field staff of O'Brien Gold Mines.

G. G. Dobbs, who recently returned to London from Canada, has been appointed assistant general manager of the Gold Coast Selection Trust.

Clyde M. Eye, mining and metallurgical engineer, arrived in San Francisco from Manila, P. I., for a prolonged stay in the Bay area.

J. G. Traill has taken up his duties as assistant manager of the Mill Close Mines, Ltd., Derbyshire, England, under Leslie B. Williams, general manager.

Philip Carpenter, who left the staff of Wright-Hargreaves Mines, Ltd., in November last, is now with I.C.I. (Lime). Ltd., at Buxton, Derbyshire, England.

Jesse L. Maury has been appointed associate mine valuation engineer for the Securities and Exchange Commission, with headquarters in Washington, D. C.

Dallas Becker, formerly a junior assayer at the United States Assay Office, New York City, has accepted a position as assayer at the Haile Gold Mine, Kershaw, S. C.

C. W. Workman is superintendent of Central Porcupine Mines, which is meeting encouraging results in its exploration of the ground between Hollinger and Dome.

J. Moore Samuel, consulting engineer, has opened an office at Room 450 Roosevelt Building, Los Angeles, Calif. Mr. Samuel was for 24 years associated with the Phelps Dodge Corporation.

Wesley P. Goss, formerly assistant superintendent of United Verde Copper Company at Jerome, Ariz., is now holding the same position with the Park City Consolidated Mining Company at Park City, Utah.

L. Lennox, metallurgical engineer, until recently with The Merrill Company, San Francisco, sailed for Manila, P. I., late in May to become consulting metallurgist of Benguet Consolidated Mining Company.

R. J. Parker, assistant to the managing director of Roan Antelope, Rhodesian Selection Trust, and Mufulira Copper, has returned to London after a visit of several months to the properties in Northern Rhodesia.

C. M. Loeb, Jr., of Climax Molybdenum Company, New York City, left for Europe early in June on a business trip of two and a half months, in the course of which he will visit England, France, Germany, and Russia.

Webb Smith, for 25 years superintendent for Kennedy Mining & Milling Company, Jackson, Calif., resigned his position on account of ill health. He is succeeded by **William Sinclair,** formerly foreman at the Kennedy mine.

C. D. Stevenson is superintendent at Pamour Porcupine Mines, which has lately been financed by Noranda for the development of an extensive new gold-bearing zone to the north of the productive area of the Porcupine camp in Ontario.

A. M. Richmond, resident mining engineer for the No. 6 Mineral Survey District, with headquarters at Vancouver, B. C., has recently been appointed resident mining engineer for the No. 3-4 Mineral Survey District, with headquarters at Penticton, B. C.

Charles F. Jackson, recently manager of the Bussieres mine, in Louvicourt Township, Abitibi County, Que., is taking a short holiday following suspension of operations at the mine on April 1, prior to resuming his duties with the United States Bureau of Mines.

Errol MacBoyle, vice-president and general manager, Idaho Maryland Mines Company, is in Washington, D. C., to attend the meetings of the national advisory board of the United States Bureau of Mines, of which he is a member representing the gold-mining industry.

Fusaichi Matsui, mining and metallurgical engineer, and **Sueo Hayashi,** mechanical engineer, both professionally associated with the Furukawa Electric Company, Inc., of Tokyo, Japan, spent some time in New York last month in the interest of the Furukawa company.

H. P. Robertson, formerly of Australia, is manager for Lacey Gold Mining Company at Chester Basin, Nova Scotia. **P. Luscombe Carroll, Frank E. Keevil,** and **George L. Walton,** all of London, are directors, representing the syndicate that has financed the development of the mine.

C. B. Holcombe, formerly employed in the milling department of the Fresnillo Company, Fresnillo, Zacatecas, Mexico, and lately with Cia. Inversiones del Oro, La Noria, Zacatecas, is now with El Potosi Mining Company, at its concentrator at San Guillermo, San Guillermo, Chihuahua.

Harry M. Lavender, for the past three years mine superintendent of the Copper Queen branch of Phelps Dodge, has been transferred to the office of the general manager, **P. G. Beckett,** at Douglas. His position has been filled by **I. H. Barkdoll,** since 1927 general manager of Old Dominion, at Globe.

John Carter Anderson has just returned to Beverly Hills, Calif., from an examination trip in the Sierra Madre Mountains of Mexico, in the borderland between Chihuahua, Sinaloa, and Sonora, and is completing a plant to leach the tailings from the old Keane Wonder mine, in Death Valley, California.

Dr. John Campbell Merriam, president Carnegie Institution, of Washington, and **Dr. Raymond C. Moore,** State Geologist, of Lawrence, Kan., have been designated by the United States Government as official delegates to the celebration of the centenary of the Geological Survey of Great Britain, which will be held in London July 3 to 5 of this year.

M. D. Harbaugh, secretary of the Tri-State Zinc and Lead Ore Producers Association, is the author of the following poem, entitled "Grand Canyon," which was printed recently in "The Earth," published by the Santa Fe Lines, and which is here reproduced as illustrative of the varied talent of some members of the profession. Mr. Harbaugh is a geologist. The verses follow:

In a glamorous land on the top of the world
Where the sky is an endless blue,
A wedge of heaven has driven deep
And split the earth in two,
And torn its face in a jagged wound
All splotched and stained with blood
That long since poured from its riven veins
In a surging ghastly flood.

I stood one day and gazed in awe
At that gaping, beautiful gash
That stretches from dawn to the setting sun
Like the trail of a dragging lash;
And I looked for miles to its deepest depths
And beheld with my wondering eyes
The sinuous edge of that mighty wedge
That still bears down from the skies.

Then I trembled to think of the fearful powers
That buffet the world and me,
And I pitied the earth that since its birth
Has suffered so patiently;
But then I began to understand
How a life is shaped and steeled,
And made both rugged and beautiful
By the scars where its wounds have healed.

Charles C. Samuels, manager of the Sunshine Mining Company, operating near Kellogg, in the Coeur d'Alene district of Idaho, since 1926, and **James E. Ducelle,** mine superintendent of the company since June of that year, resigned on May 1 to reside for the summer on the Pacific Coast. They are expected to resume professional activities in Idaho in the fall of this year.

Guy Hunner, of Iron River, and **Ocha Potter,** of Ahmeek, well-known mining men of the Upper Peninsula of Michigan, were elected to two of the leading offices in the Isle Royale National Park association, organized at Escanaba, Mich., recently. Mr. Hunner is superintendent of the Zimmerman mine, at Iron River, for the M. A. Hanna Company, and Mr. Potter is superintendent of operations in the Ahmeek district of Michigan for the Calumet & Hancock Consolidated Mining Company. The association has been formed for the purpose of hastening, if possible, the consummation of a new national park on Isle Royale, in Lake Superior.

Arthur C. Brinker has returned to New York after spending sixteen months in the Lupa gold field, in East Africa, assisting Amor F. Keene in the examination of the properties of the East African Goldfields, Ltd. After Mr. Keene's departure in April, 1934, Mr. Brinker remained in Africa to carry on the development campaign and to build a modern mining camp, which was completed about the first of 1935 and consists of a 350-hp. superheated steam power plant, with compressors, shaft equipment, and complementary machinery and devices, and, also, accommodations for 50 Europeans and more than 2,000 native employees. Mr. Brinker is in New York on business and will remain for a month or so.

OBITUARY

Frank Robert Williamson, manager of Sub Nigel, died in the Far East Rand Hospital on April 23.

Percy Peach, long identified with mining interests in Southern Rhodesia, died recently in the Sinoia district.

Leopold Reinecke, consulting geologist for New Consolidated Gold Fields of South Africa, died at sea recently. He was 51.

William Henry Harris, a pioneer in Kimberley and the Transvaal, died recently at Benoni, South Africa, in his 82d year.

Robert C. Clark, pioneer mining man of the Canadian North, was killed in an automobile accident at Wanatah, Ind., on May 18.

John Muir, mining engineer, long associated with the mining industry of South Africa, died recently at Johannesburg. He was 62 years old.

Edmund Burgis Kirby, mining and consulting engineer, and a former vice-president of the A.I.M.E., died last month in New York. He was 76 years old.

Charles Thomas Lupton, a consulting geologist, of Denver, Colo., and known internationally as a distinguished member of his profession, died recently in Denver, at the age of 57.

Dr. Charles H. Clapp, president of Montana State University, and in the early nineties instructor in geology and mining engineering at M.I.T. and at the University of North Dakota, and formerly Assistant State Geologist of North Dakota, died recently at Missoula, Mont., at the age of 51.

William J. Olcott, aged 73, president of the Oliver Iron Mining Company for nineteen years, died in Pasadena, Calif., on April 29. He retired from the company in 1929. Mr. Olcott was a member of the A.I.M.E. and a charter member of the Lake Superior Mining Institute, of which he was president in 1902. Interment was at Duluth, Minn.

Mrs. May B. Lindley, metallurgist, scientist, and writer, the widow of Morton Lindley, mining engineer and geologist, died recently at Oakland, Calif. Latterly she had been interested in mining projects in Oregon.

Michael P. Dalton, 66, superintendent of mills for the Federal Mining & Smelting company for the past 30 years, died recently at Wallace, Idaho. Mike Dalton was known throughout the Northwest as an authority on milling operations. He was among the pioneers to develop the flotation process. He came to the Cœur d'Alene district some 40 years ago. His first work was as foreman of the Tiger-Poorman mill. He went with the Federal company to the Morning mill, at Mullan, in 1905, and had been with that company since that time. He was frequently called into consultation on milling matters and superintended the construction of a number of concentrating plants in the Northwest.

James Chambers Dick, 63, one of Utah's leading mining engineers, died at his Salt Lake home May 1 after a prolonged illness. Mr. Dick had been actively identified with Utah mining ever since 1899. In 1903, he married Mathilde Dern, daughter of the late John Dern and sister of George H. Dern, Secretary of War. Mr. Dick was born at Fallsbrook, Pa., May 28, 1871, the son of Robert and Elizabeth Dick. He was educated at Clarion State Normal School, Pennsylvania, and Lehigh University. In 1899, he made a geological survey for the Clear Creek, Utah, coal field. Later he was mining engineer for the Consolidated Mercur Gold Mines at Mercur. In 1904, he became chief engineer for the Utah Copper Company at Bingham. After the war, Mr. Dick was chief of the metal mines engineering division, and later head of the natural resources division. In 1920 he re-entered the field of consulting engineering.

LETTERS

Corduroy as a Gold Saver

The Editor:

With regard to the article by Mr. von Bernewitz in the February issue of *E.&M.J.* it occurs to me that one or two points in connection with the use of narrow and wider types of rib in corduroy might possibly be of interest.

Given similar fabrics, under similar test conditions, a wider spacing of rib will give, up to a certain point, a proportionately greater bulk-collection. Other factors, however, immediately come into play, and, though bulk increase of "collection" obtains, such may be minus a commensurate increase of gold, where the concentrate included a good deal of heavy specific-gravity, low-grade material. It is, therefore, quite impossible to recommend one rib type more than another, and actual try-out is the only means of determining the relative merits in regard to any given operation or the particular type of concentrates obtaining.

Against the higher "collective" capacity of a wider-spaced rib, also, must be balanced the technical point that, owing to such wider spacing, the "valley" of the rib is a little more exposed and the "nap" threads are a little longer (and therefore softer). Accordingly, a wider rib will naturally tend toward greater friction and to wear away against the pulp flow fractionally more than a narrower rib type of similar material.

Summing up, and generally speaking, for all-round usage (with varying types of pulps) the narrower rib type would always give satisfactory service and hold a strong position as regards recovery efficiency plus length of life—and particularly where no immediate opportunity for a full comparative try-out can be made possible.

JAMES JOHNSON,
per Frank Smith, Manager.
Manchester, England.

A Correction in The Milburn Formula

The Editor:

Referring to my notes on the cost of shaft sinking published in *E.&M.J.*, May, 1935, page 257, I note a typographical error in the formula which reads

$$C = KA^{0.65}\sqrt{100 + {}^{5}d}$$

but which should read

$$C = KA^{0.65}\sqrt[5]{100 + D}$$

Berkeley, Calif. T. H. MILBURN.

Should Assessment Work Be Suspended?

The Editor:

Since July 1, 1931, it has been possible for the locator of mining claims to hold them without doing any assessment work. More recently a limit has been set to the number of claims an individual may so hold, and he must make an affidavit that he paid no income tax for the previous calendar year in order to hold his claims without work.

Now, I am in full sympathy with the poor man who pays no income tax, but however low in pocket he may be, he still, I assume, has his health and strength. The country needs new mines because mines help employment. If our locator is unemployed, how better can he spend his time than in trenching his outcrops? If employed, he can pay another to do this work. One pick, one shovel; that is all he needs until he has exposed his ore in several places. Certainly it is the wrong time to slack up on requirements for assessment work.

While we still have in each state a number of counties suited to our stage-coach days, one county official can easily be found to check and measure the work done by holders of unpatented claims. Why not try it?

Denver, Colo. A. W. NEWBERRY.

Dragline Excavators in Placer Mining

The Editor:

We note with interest Mr. Fox's article in the April *E.&M.J.* describing dragline excavators in placer mining. The data given therein are interesting and will prove of benefit to the miner who has a small deposit, limited working capital, or other conditions which make the use of this type of machine desirable and economical. We do not agree, however, with the statement that the gold-saving plant located on a scow is not satisfactory. In the summer of 1907 or 1908, C. W. Purington and J. P. Hutchins worked a dragline excavator on fairly rich ground in Siberia, discharging into a fixed sluice somewhat similar to illustration No. 1 in the article referred to. A 10-in. centrifugal pump was used to supply water for the sluice. Though the operation of the dragline excavator was satisfactory, the difficulty of moving the equipment and disposing of the tailings, as well as the unsatisfactory washing, were decisive factors in causing the operators to abandon this mode of operation.

The New York Engineering Company then built for them a gold-saving device on a scow which was termed a "stacker scow." Essentially it was the same as decribed in the aforementioned article and pictured in Fig. 5, except that it was located on a hull; in addition to the standard gold-saving device, it had a log washer on board to break up the stiff clay which was encountered in this deposit. This equipment worked very satisfactorily for two seasons until a bucket line was added to the extended bow of the scow and a standard dredge made of it.

The dragline excavator was one of the earliest excavators of this type built and was powered by means of a wood-fired boiler. The floating plant solved the tailing problem and the washing problem and was far more economical in operation than the original equipment.

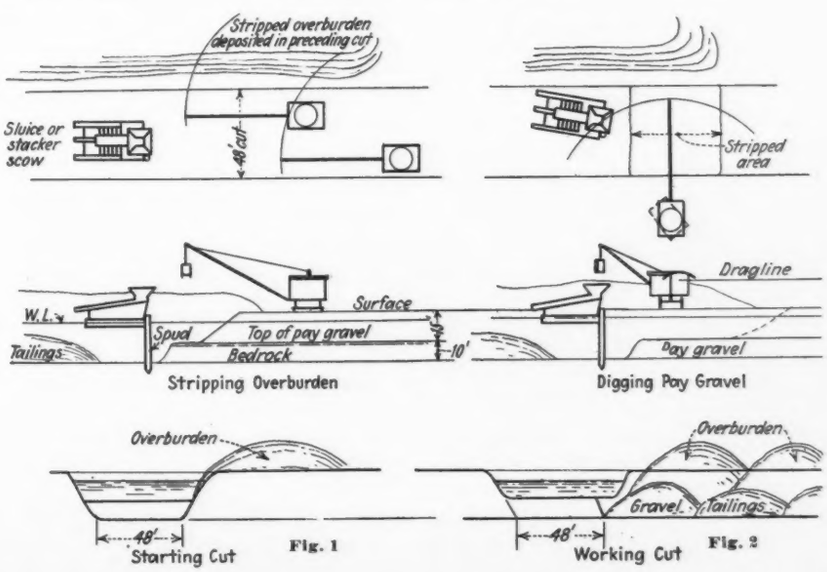
It is true that certain kinds of bedrock cannot be cleaned by means of a dragline excavator, but bedrock of this type would be very undesirable for any kind of operation except hand cleaning, which will be handicapped where the bedrock is below the natural water level of the deposit.

Using a floating type of machine or stacker scow has the additional advantage of extreme flexibility in the mode of digging, especially if the deposit is not in a narrow gulley or the pay streak too confined. The Winston Contracting Company is working a stacker scow in conjunction with a 2½-cu.yd. Monighan excavator in Montana, which represents the latter type of deposit. The dragline excavator in this case is working upstream, stripping part of the overburden, and throwing it to either side of the pay channel, leaving the tailings on the downstream side of the workings. The dragline excavator can also be put crossways to the deposit or the stripping can be done in line with the progress of the machine and the digging of the pay dirt across the channel. This reduces the swing of the machine to a minimum and increases the yardage considerably.

The first method mentioned is very similar to standard dredge operation. The second method is illustrated by appended sketches. Fig. 1 shows plan and elevation of the stripping operation, and Fig. 2 shows the same of the digging and washing operation.

NEW YORK ENGINEERING COMPANY.

New York, N. Y.



NEW BOOKS

Hammond's Own Story Of His Life

THE AUTOBIOGRAPHY OF JOHN HAYS HAMMOND. *Farrar & Rinehart, Inc., 508 W. 26th St., New York. Pp. Vol. I, 385; Vol. II, 813. Price $5.*

Early in this absorbing personal narrative the author makes a significant comment on his ancestors: "Most of the Hammonds had led adventurous lives from the time they first left England and settled down in Maryland." After reading the autobiography one realizes that John Hays Hammond upheld the family tradition in the most adventurous manner. His professional life took him to all parts of the world in an era when mining communities were primitive and every camp had its rough characters. So Mr. Hammond is no armchair commentator as he unfolds the details of a busy and successful career.

There is a great temptation in reviewing this autobiography to quote extensively and relate one interesting incident after another. But that would only dull the edge of pleasure for the reader. Suffice it to say that the work is replete with stories and anecdotes, philosophy and opinion on many subjects, and incidents of courage and bravery in the protection of life and property.

Mr. Hammond's interest in mining was gained during his boyhood in California, where he was born in 1855—six years too late to claim the distinction of being a "Forty-niner." After attending Hopkins Grammar School and Yale University he went to Freiberg, Germany, for his technical education. On his return to the United States he found his "book learning" a handicap to employment by the mining operators in California, who preferred to place their faith in more "practical" men. So he got his first job by solemnly assuring his prospective employer that he "didn't learn anything at Freiberg." Later he was to demonstrate the value of that training and to sustain his contention that "the specialist is worthy of his hire."

Throughout his career Mr. Hammond met and associated with eminent and distinguished men. Hence we find references to his acquaintance, more or less intimate, with General Sherman, President Grant, Hadley of Yale, George Hearst, D. O. Mills, J. G. Blaine, "Barney" Barnato, Baron Rothschild, Dr. Jameson, and Cecil Rhodes. In his later years when he "prospected in politics" he was closely associated with Theodore Roosevelt, Taft, Wilson, Harding, and Coolidge.

If one were to select the most dramatic experience of his career it would undoubtedly be his service in South Africa as a confidant and adviser to Cecil Rhodes, the "empire builder." There he participated in the revolt against the Boers, was tried and convicted of treason, and sentenced to be "hanged by the neck till you are dead." But this tragic end was averted by a strong revulsion of public sentiment that ultimately resulted in Kruger's "magnanimity by inches" to a point where a fine of $125,000 was imposed on Hammond and each of the other leaders of the revolt as the price of their freedom.

Of his later years in the United States Mr. Hammond writes entertainingly of his association with the Guggenheims and his experience with the Camp Bird, Tonopah-Belmont, Stratton's Independence, Utah Copper, and other well-known mining properties. In his final chapter, "In Retrospect," he gives an insight into his family life, his interest in boys, his wife's civic and philanthropic work and other personal activities crowded into an active life at eighty years. Every mining engineer will derive entertainment and inspiration from Mr. Hammond's personal story.

Sintering and Roasting

SAUGZUG-SINTERN UND RÖSTEN. *By Helmut B. Wendeborn. Published by VDI-Verlag G.m.b.H., Berlin. Pp. 115.*

A discussion of the chemical and physical conditions underlying sintering and roasting processes. The first part of the volume deals with the treatment of sulphidic ores, pyrites, blendes, and lead and copper ores. A chapter is also devoted to the endothermic reactions involved in the sintering of cement, the most recent application of the sintering process. In the second part the author presents a treatment of the thermal processes involved in the various steps of roasting and sintering. Many examples from practical operations are given.

For Wider Use of Logs

LOGARITHMS, NUMERICAL AND GRAPHICAL. *By N. R. Corke. Gee & Co., Ltd., London. Pp. 80, 8½x11 in. Price post free United Kingdom 8s.; abroad 9s. 3d.*

Believing that logarithms offer a more extensive medium of mathematical calculation than is now commonly practised, the author has designed a book for self-study and the practical use of logarithmic methods. The contents include an elementary introduction to the subject, the use of log tables in technical, commercial, and actuarial calculations, instructions for use of the slide rule, semi-log, and log graph paper, and alignment charts. Two appendices contain appropriate tables.

Publications Received

Gold in the Gold Coast, with an appendix on Gold Coast Laws and Their Effect on Mining. By N. R. Junner and R. P. Wild, respectively. Memoir No. 4. Gold Coast Geological Survey, 75 Cornwall Gardens, London, S.W. 7, England. Pp. 76, with colored geological map supplement. Price 8s.

Imperial Institute, Annual Report 1934. Published by John Murray, Albemarle St., London, S.W. 1, England. Pp. 54.

Lithium — Theoretical Studies and Practical Applications. By Hans Osborn and B. S. Hopkins. The Electrochemical Society, New York. Pp. 68.

Essentials in Developing and Financing a Prospect With a Mine. By Charles W. Wright. Information Circular 6839, U. S. Bureau of Mines, Washington, D. C. Pp. 22.

Metal Statistics for 1935. Twenty-eighth Annual Edition. Published by American Metal Market, 111 John St., New York. Pp. 560. Price $2.

Milling Methods, 1934. Vol. 112 of Transactions of the American Institute of Mining and Metallurgical Engineers. Sponsored by the Rocky Mountain Fund and dedicated to Prof. Robert H. Richards. Pp. 977. Price, $5, net, bound in cloth.

Tinplate and Canning in Great Britain. Bulletin 1 of the International Tin Research and Development Council, 149 Broadway, New York.

Rock Wool From Illinois Mineral Resources. Bulletin 61, Illinois State Geological Survey, Urbana, Ill.

Nova Scotia Annual Report of Mines, 1934. Department of Public Works and Mines, Halifax, N. S. Pp. 229.

Summary of Drifting and Crosscutting Cost Data. By Charles F. Jackson. Information Circular 6825. U. S. Bureau of Mines, Washington, D. C. Pp. 15.

Beneficiating Cement Raw Materials by Agglomeration and Tabling. By F. P. Diener, J. Bruce Clemmer, and S. R. B. Cooke. Report of Investigations 3247, U. S. Bureau of Mines, Washington, D. C. Pp. 6.

Progress in Tin Research. Bulletin No. 2 of International Tin Research and Development Council, 149 Broadway, New York. Pp. 12.

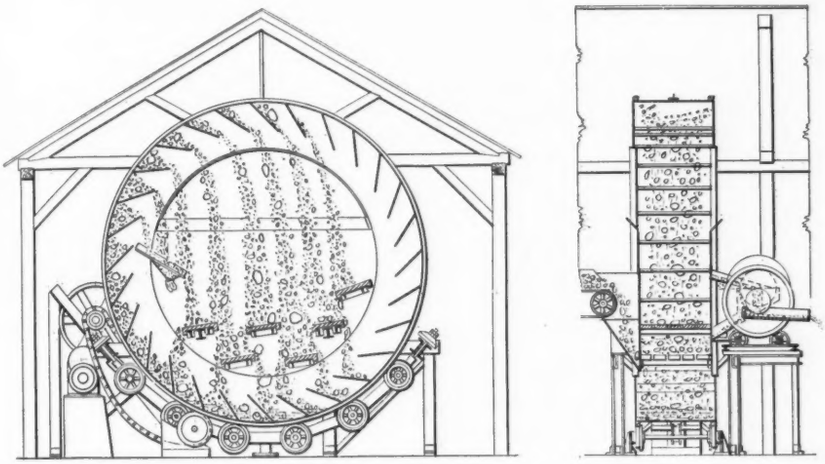
Revival of the Guanacevi Mining District (Problems Bearing on the). By Alberto Terrones Benitez, Calle Tacuba 92, Mexico, D. F. Pp. 20. (In Spanish.)

Kyanite and Vermiculite Deposits of Georgia. By Louis M. Prindle and others. Bulletin 46, Geological Survey of Georgia, 425 State Capitol, Atlanta, Ga. Mailed on receipt of postage. Weight 2 lb.

EQUIPMENT NEWS

Hadsel Mill Redesigned—Six Units Working

As Now Built, Friction Is Eliminated, Classification Controlled
Eight Different Ores Have Been Handled



Harlow Hardinge

Vice-President and General Manager,
Hardinge Company,
York, Pa.

Fig. 1—The drum of the new Hardinge-Hadsel mill is mounted on wheels having anti-friction bearings. The outside tank used in the earlier model has been done away with and a separate outside classifier substituted

• Since its introduction three years ago, the original "Hadsel mill" has undergone extensive development by the Hardinge Company. The history of this invention is enlightening, to say the least.

The interest shown in the original mill indicated that a real demand existed for a crushing and grinding unit of a type that would take run-of-mine ore and reduce it in one operation to the product desired. This result the original mill accomplished at remarkably low power costs. The first commercial sizes were built with the drum supported by an overhung shaft, on which were located inside and outside buckets with stationary breaker plates suspended from the opposite tank wall into the drum. The whole drum was partly submerged in a narrow tank. An overflow weir on one side, with an adjustable baffle, was used to obtain the proper classification. The ore was fed into the center of the drum, where it was raised by the inside buckets and dropped on the breaker plates from a considerable height. The fines were suspended in the water and were discharged at the overflow weir. Coarse ore settled back in the buckets. Intermediate sizes settled in the tank, which was scooped out by the outside scoops and deposited back in the drum for further treatment.

Although this original design crushed and ground both hard and soft ores at remarkably low requirements as to power and operating labor, the maintenance cost (due mainly to the cementing of sulphides in the bottom of the tank, causing friction on the outside scoops) was so high as to make an otherwise revolutionary and remarkable operation anything but satisfactory. A "critical" size also built up inside of the mill with a certain type of ore and lowered the capacity considerably at times.

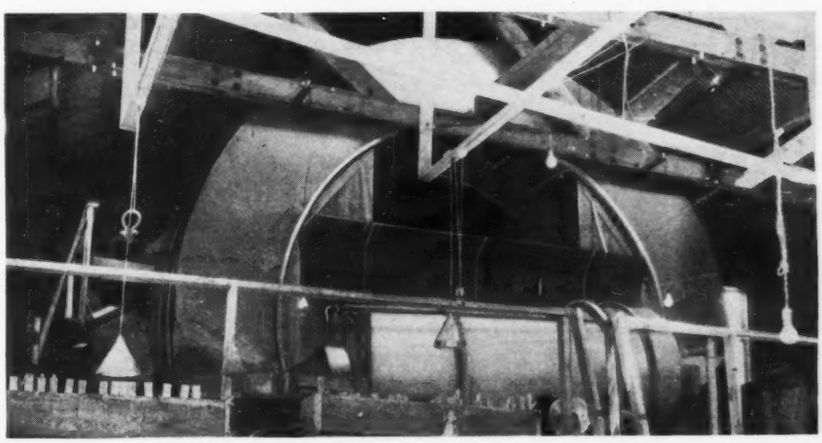
As soon as these defects were uncovered, the Hardinge Company ceased all active efforts to push the sale of the mill and devoted the next year (1933) to its mechanical development, with the idea of retaining the principle of grinding, but so altering the construction and operation as to eliminate all serious defects. Not until 1934 were means employed which definitely solved the problem and a new design of mill was placed in operation at several properties.

In the new design, the tendency for one size of particle to build up in the mill was eliminated entirely, even with the most difficult types of ores, inasmuch as the new mill did away with the outside tank entirely as well as with any tendency of the critical size to segregate in certain parts of the mill. Not only did it grind the very ore that caused so much trouble before, but in six different installations it has ground eight different types of ore (one installation handling ore from three different properties) with results surpassing expectations in every instance. External and internal friction is eliminated and there is a definite control of classification, independent of the grinding action.

The basic principle of the original mill is retained in the present design in that the ore is lifted in buckets inside the drum and dropped on sloping breaker plates at a sufficient height to cause a violent crushing and grinding action, free of interference between particles undergoing reduction; but there the similarity ends.

By referring to Fig. 1 the new method of operation can be readily understood. The drum is suspended in the cradle on wheels equipped with roller bearings. When the mill is empty it can be turned freely by one man, so low is the frictional resistance. The walls extend beyond the buckets, so that the drum operates as a self-contained unit. The ore is dropped on the breaker plates, where both fines and coarse drop back into the buckets again,

Fig. 2—One of the redesigned grinding units. This Hardinge-Hadsel mill is working at a mine plant in New Mexico. In front of it is seen the 4x10-ft. Hardinge counter-current classifier with which it is in closed circuit



enough water being added to the mill to create the proper consistency.

On the rising side of the mill, ahead of the first breaker plate and above it, is located a take-off grizzly. This is the heart of the operation of the unit, as this grizzly rejects the coarse oversize and allows it to pass directly back into the mill on the first breaker plate, while the undersize flows by gravity to an outside classifier, where in turn the final classification takes place, in which products ranging anywhere from 20 mesh on up to 200 mesh are obtained through the ordinary means of control of classifier speed, density, and other factors. Oversize from the classifier returns to the mill, also by gravity, and thus the cycle is completed.

The new mill seems to balance its operation automatically when the feed varies in size. For instance, when all that is coming from the bin is coarse, there is an excess of large pieces, which causes a reduction in the load on the plates and the decrease of "bed" increases the tendency to break the large pieces rapidly. On the other hand, if all fines are fed with a deficiency of coarse pieces, the plates will load up a little thicker, increasing the mass action on them, which aids in fine grinding and prevents the coarse pieces, such as are available, from being broken down too rapidly. In actual operation, mills in several installations have been run for long periods without even being inspected by the operator, who was busy elsewhere.

I present two typical operating reports taken from actual mill records, one on a small 50-ton mill and the other on a larger mill of more than 200 tons' capacity. The data submitted were obtained in the first part of 1934. Inasmuch, however, as the Hardinge Company had had the very unfortunate experience of putting its name behind a product of so much apparent merit, and of finding later that it had made a mistake in assuming that the mill had been commercially developed previous to its acquisition, no public announcement was made of the results. To avoid the chance of recurrence of a similar experience, it refused to advocate the broad use of the mill and confined all its efforts to developing it, and waited until a sufficient time had elapsed and the mills, with the latest developments, had operated sufficiently long and had ground many thousands of tons under all conditions, to establish beyond all question of a doubt that no new troubles or difficulties would be encountered.

Six different installations of the new design of mill, that have ground eight different classes of ore, are now in operation. Several of them have now been run long enough to establish the maintenance costs, which are mainly confined to the breaker plates and bucket lips. It is safe to say at this time that, except in unusual cases, not as yet encountered, the metal consumption will not exceed ½ lb. per ton in a large mill and ¾ lb. per ton in a small one. When this is compared with the equivalent metal consumption of crushers, rolls, screens, elevators, conveyors, ball-mill liners, and balls, it is evident that the last question concerning this radical type of mill has been definitely answered.

Any number of engineers have stated that they believed in the principle of the mill, but they would never consider its installation until it had run long enough definitely to prove that it was mechanically correct and all wearing points ascertained. We have now waited long enough to satisfy the most skeptical engineer on this point, and not until now have we stated positively and definitely that the Hardinge-Hadsel mill has passed through the development period and is both metallurgically and mechanically correct and is revolutionizing the present established methods of crushing and grinding of ores. If this statement were based upon the operation of only one unit, it would be subject to question. It is not. Surely six installations, that have ground eight different classes of ore, should be proof enough.

The cost curves submitted here are based on actual results with a margin to spare, and are taken from records and estimates of units with capacities varying from 50 to 225 tons. Beyond 225 tons the costs are estimated, but run practically parallel to the equivalent crusher ball mill curves as drawn from the data compiled by the United States Bureau of Mines reports covering crushing and grinding costs of various installations throughout the United States.

OPERATING DATA—Two Hardinge-Hadsel Mills

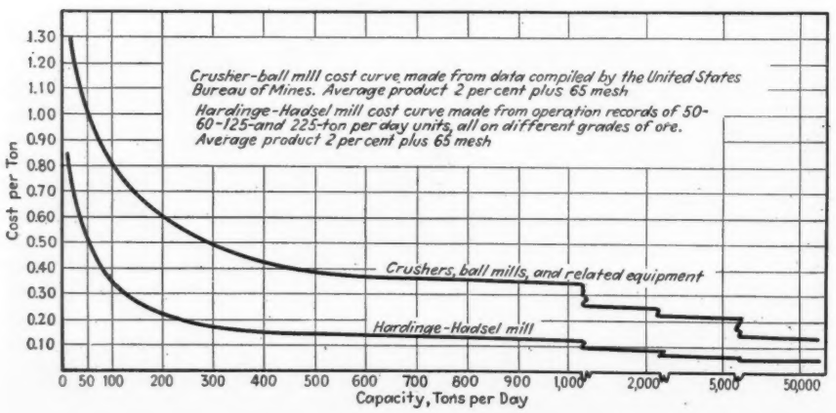
● **AT THE SLIDE MINES, near Boulder, Colo., a Hardinge-Hadsel mill is grinding a gold ore composed of quartz stringers in granite in closed circuit with a Hardinge counter-current classifier. The product goes to concentrating tables followed by flotation. Operating data follow:**

Mill—20-ft. diameter Hardinge-Hadsel mill
Classifier—3x8-ft. Hardinge counter-current classifier
Feed—Run-of-mine ore. Maximum size 10x15 in.
Product—5 per cent plus 65 mesh
Capacity—55 tons per 24 hours
Power—29 hp.
Speed of mill—3.0 r.p.m.
Per cent solids in classifier overflow, 35 to 40.

● **ANOTHER MILL, IN CALIFORNIA, is grinding ore from three different mines. Two-thirds of the ore is a tough altered schist and one-third is quartz. The subsequent treatment is flotation followed by cyanidation of the concentrates. The data follow:**

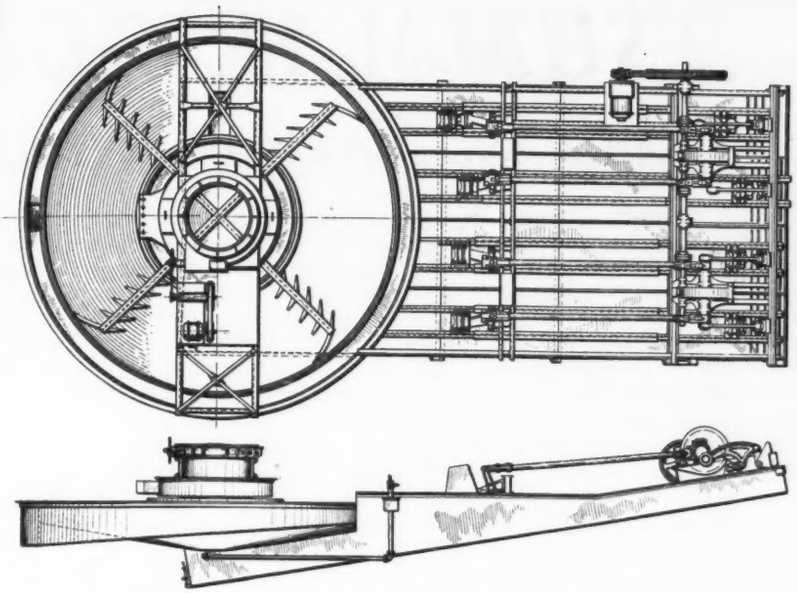
Mill—24-ft. diameter Hardinge-Hadsel mill
Feed—Maximum size of piece, 8x15 in.
Product—0.7 per cent plus 80 mesh, 71.7 per cent minus 200 mesh
Capacity—232 tons per 24 hours
Power—90 hp.
Speed of mill—2.67 r.p.m.
Estimated metal consumption of breaker plates and buckets—¼ lb. per ton

Fig. 3—Comparative costs of grinding with Hardinge-Hadsel mill and with crusher, ball mills, and related equipment. Labor, power, repairs, and maintenance are included. For tonnages exceeding 225 per day the figures are estimated


Crusher-ball mill cost curve made from data compiled by the United States Bureau of Mines. Average product 2 per cent plus 65 mesh
Hardinge-Hadsel mill cost curve made from operation records of 50-60-125-and 225-ton per day units, all on different grades of ore. Average product 2 per cent plus 65 mesh
Crushers, ball mills, and related equipment
Hardinge-Hadsel mill
Cost per Ton
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0 50 100 200 300 400 500 600 700 800 900 1,000 2,000 5,000 50,000
Capacity, Tons per Day

A Rotary Planer for the Mine Carpenter Shop

● Applicable wherever wood surfaces are to be smoothed, shaped, or reconditioned, a new portable electric rotary planer introduced by Black & Decker Manufacturing Company, Towson, Md., will be found serviceable in the carpenter shop of any mine. It consists of a heavy-duty driving unit with a universal motor and two interchangeable planer heads for gouging and surfacing, respectively. Shaped disks 5-in. in diameter in which are set three planer blade cushions, and simply adjustable for either deep or shallow cutting, constitute the head. As shipped, each unit includes a driving mechanism, detachable side handle, a three-conductor cable and plug, as well as the gouging and surfacing planer heads.



Essential parts of the new turret-bowl classifier, in two views. To simplify the sketch, such details as the bowl and reciprocating rake drive unit and the vertical steel legs supporting the bowl around its periphery have been omitted. Likewise, the structural steel members supporting outboard ends of the transverse beam carrying the turret

Bowl Classifier Design Improved

• By doing away with the conventional, tripod-type superstructure of its bowl classifier, and substituting therefor a low, compact bowl-drive unit resembling the gun turret of a battleship, The Dorr Company, of New York, has reduced the headroom required to a minimum and at the same time has improved the bowl-drive unit and in general made the construction heavier and stronger throughout. The new classifier has been given the name of "Turret-Bowl." It may be had in bowl sizes ranging from 9 to 25 ft. in diameter, with reciprocating raking mechanisms from 4 to 16 ft. in width. It is also built for normal operating service and for extra-heavy service. The company claims that it brings to the secondary and tertiary classification stages the same high standards of classifier construction that the Types F and FX classifiers have already brought to the primary stage.

The new drive unit consists of a motor, direct-connected to a worm and worm gear, running in an oil bath within the turret. In this unit the latter is sealed. The entire drive unit is supported by two steel beams spanning the bowl. Throughout the classifier heavier construction has been used. The bowl rakes are deeper and stronger. Likewise, beam supports are stronger and more rigid than the supplanted superstructure, which was built of relatively light shapes. The accompanying sketch shows the essential parts of the redesigned unit in two views.

An important accessory part is the automatic critical size control, which has been developed by the company for recycling material directly under the bowl close to the mesh of separation. This critically sized material is returned to the feed well by an automatically controlled air lift and given repeated opportunities to leave the classifier either as an overflow or as a rake product. This cuts down the amount of oversize in the overflow and of the undersize in the rake product and gives a higher over-all classification efficiency.

E.R.P.M., on Rand, to Cool Mine Air By Refrigeration

• To cool the air in the East Rand Proprietary mine, at Johannesburg, South Africa, the York Ice Machinery Corporation, of York, Pa., has been commissioned by the Central Mining & Investment Corporation to furnish and install a complete system of mechanical refrigeration and air-conditioning. Rock temperatures in the East Rand mine are 95.7 deg. F. and humidities are exceptionally high.

The air-conditioning plant will be installed 6,800 ft. below the surface, or 1,050 ft. below sea level. It will cool 150,000 cu.ft. of air per minute, drawing fresh air down from the surface through a special airshaft. Washing, cooling, and dehumidifying are to be accomplished in a York dehumidifier 18 ft. wide, 13 ft. high, and 7 ft. long. When the air has served its purpose it will be gathered into an upcast shaft, passed through a large cooling tower, and forced to surface and discharged to atmosphere.

The refrigerating equipment consists of two York heavy-duty four-cylinder Freon compressors 12½ in. in diameter and 10 in. stroke. Each is direct-driven by 250-hp. synchronous motors and produces 300 tons of refrigerating effect, so that the plant has a total capacity of approximately 600 tons of refrigeration. A "ton of refrigeration" is the amount of refrigeration capacity in any system which will remove 12,000 B.t.u. per hour. It amounts approximately to the refrigerating effect necessary to produce 1 ton of ice in one day. The refrigerant to be used will be dichlorodifluro-methane, known as Freon.

Condensing water for the system is to be supplied from a pond of 84 deg. F. water, 360 ft. above the 6,800-ft. level. The cooling tower will be installed directly above this. Approximately 2,000 gal. of water per minute will be circulated from the pond through the four large York shell-and-tube condensers and discharged over the cooling tower. The refrigerated water, about 2,400 g.p.m., is circulated through two York shell-and-tube water coolers, and is sent to air-washing sprays in the dehumidifiers.

INDUSTRIAL NOTES

• Straub Manufacturing Company, Inc., Oakland, Calif., has transferred its manufacturing rights in Canada to the Canada Iron Foundries, Ltd., Montreal. The latter has five manufacturing plants at strategic points in Canada. All sales will be handled by their subsidiary, Canadian Straub, Ltd., 1188 Phillips Place, Montreal, Quebec. This sales organization is headed by W. D. Watson.

• Harnischfeger Corporation, of Milwaukee, and the Caterpillar Tractor Company, of Peoria, Ill., have announced a cooperative arrangement for building diesel-powered generator sets under the name of Harnischfeger-Caterpillar. These sets will range in capacity from 35 to 60 kw. and will fill all a.c. and d.c. requirements for service in mines and quarries. The generators are of the single bearing type directly connected by link coupling to the diesel engine and mounted on a substantial cast-iron base. Production is under way.

BULLETINS

Switches. General Electric Co., Schenectady, N. Y. Bulletin GEA-2127 on knife switches. Also GEA-2123 on an outdoor, drop-out fuse disconnecting switch and GEA-1972 on a high-speed oil-tight circuit breaker.

Flotation. Denver Equipment Co., Denver, Colo. Bulletin 3501 on flotation with the Denver Sub-A cell (pp. 16). Also a leaflet on the Denver unit-flotation cell; an 8-page folder on Denver (company's) milling plants; a leaflet (No. 3507-B) on amalgamating and concentrating mills; and leaflet No. 3507-A on portable mills.

Pumps. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Leaflet 2199 on a single-suction, single-stage centrifugal pump designed as a complete unit with the driving squirrel-cage motor.

Motors. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Leaflet 2183 on Type E d.c. motors and generators and Leaflet 2100 on wound-rotor induction motors.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin W-321-B2A on Monobloc (motor incorporated) centrifugal pumps (¼ to 7½ hp.). Also Bulletin W-318-B6A on two-stage volute pumps, of 130- and 325-g.p.m. capacity.

Compressors. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin L-621-B6, on vertical single air compressors, single stage, and Bulletin L-620-B8 on vertical angle air compressors, two stage.

Lettering Guides. Wonham, Inc., 44 Whitehall St., New York. Wrico lettering guides (With these lettering in various sizes and styles can be done, using water color in a patented "brush pen."

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

COPPER producers were highly elated over the upward movement of foreign prices, and toward the close of the month it became quite evident that an advance in the domestic quotation was near at hand. But, on May 27, the Supreme Court rendered its sweeping decision voiding all Government enforcement of NRA codes, and the entire copper market was thrown into a state of confusion.

Producers, after a meeting held in New York, May 28, issued the following statement:

> "There was a meeting of the Copper Industry today to consider the situation which has developed from the decision of the Supreme Court on the NRA case yesterday. It was unanimously decided to take no action involving any change in the status or procedure under which the industry has been operating pending further developments in Washington and the clarification of the situation."

Though the price of copper held at 9c., Valley, up to the close of the month, the Blue Eagle designation, having been shorn of its legal status, existed in name only over the last four trading days of May. Domestic sales for the month totaled about 27,400 tons, against 26,700 tons in April and 32,300 tons in March.

Our export quotation made a new high for the movement, touching 8.175c., f.o.b. refinery, on May 27. As soon as the news on NRA developments reached Europe, heavy selling took place and the price structure weakened on some concern in speculative quarters over the future of the recently perfected international accord. Operators abroad feared uncontrolled production in the United States, which views, incidentally, were not shared on this side of the Atlantic. Demand for copper abroad was good.

Both lead and zinc prices in the domestic market moved upward, reflecting good buying as well as reasonable certainty that output will be maintained at a rate that should result in more favorable statistics. Consumption of both of these metals has increased. Inasmuch as the lead and zinc codes were free from price fixing, the markets held up well under the impact of the sudden change in the standing of NRA. The labor difficulties in the Tri-State district had a strengthening influence on prices.

Silver prices were unsettled, particularly late in the month, on selling by speculators abroad, who became disturbed over the entire "New Deal" program.

The *E.&M.J.* index of non-ferrous metal prices for May was 80.50, against 74.73 in April and 71.36 in March.

United States Market

1935 May	Electrolytic Copper Domestic (a)	Electrolytic Copper Domestic (b)	Electrolytic Copper Export (c)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1	9.00	8.775	7.400	50.950	3.75	3.60	4.100
2	9.00	8.775	7.425	50.500	3.75	3.60	4.100
3	9.00	8.775	7.450	50.550	3.75	3.60	4.100
4	9.00	8.775	7.475	50.575	3.75	3.60	4.100
6	9.00	8.775	7.475	50.550	3.75	3.60	4.175
7	9.00	8.775	7.475	50.500	3.75	3.60	4.200
8	9.00	8.775	7.500	50.300	3.75	3.60	4.200
9	9.00	8.775	7.600	50.500	3.75	3.60	4.200
10	9.00	8.775	7.675	50.650	3.75	3.60	4.200
11	9.00	8.775	7.725	50.700	3.75	3.60	4.200
13	9.00	8.775	7.775	50.700	3.80	3.65	4.200
14	9.00	8.775	7.825	50.700	3.80	3.65	4.200
15	9.00	8.775	7.800	50.850	3.85	3.70	4.200
16	9.00	8.775	7.850	51.125	3.90	3.75	4.250
17	9.00	8.775	7.950	51.600	3.90	3.75	4.250
18	9.00	8.775	7.975	51.600	3.90	3.75	4.250
20	9.00	8.775	8.000	51.450	3.95	3.80	4.250
21	9.00	8.775	7.975	51.350	4.10	3.95	4.250
22	9.00	8.775	7.925	51.600	4.25	4.10	4.250
23	9.00	8.775	7.975	52.000	4.25	4.10	4.250
24	9.00	8.775	8.050	52.000	4.25	4.10	4.300
25	9.00	8.775	8.150	52.200	4.25	4.10	4.300
27	....	8.775	8.175	51.800	4.35	4.20	4.300
28	....	8.775	8.100	51.750	4.35	4.20	4.300
29	....	8.775	7.950	51.475	4.35	4.20	4.300
30	....	Holiday	7.850	Holiday			
31	....	8.775	7.900	51.600	4.25	4.10	4.300
Av. for month		8.775	7.794	51.138	3.962	3.812	4.220
Averages for Week							
1		8.775	7.325	50.663	3.750	3.600	4.100
8		8.775	7.467	50.496	3.750	3.600	4.146
15		8.775	7.733	50.683	3.783	3.633	4.200
22		8.775	7.946	51.454	4.000	3.850	4.250
29		8.775	8.067	51.871	4.300	4.150	4.292
Calendar Week Averages							
4		8.775	7.396	50.642	3.75	3.60	4.100
11		8.775	7.575	50.533	3.75	3.60	4.196
18		8.775	7.863	51.096	3.858	3.708	4.225
25		8.775	8.013	51.767	4.175	4.025	4.267

Silver, Gold, and Sterling Exchange New York and London

1935 May	Sterling Exchange "Checks"	Sterling Exchange "90-day Demand"	Silver (d) New York	Silver (d) London	Gold London	Gold (e) United States
1	4.82500	4.81875	75.0000	34.5000	145s	$35.00
2	4.84000	4.83250	71.2500	32.3750	144s 4 d	35.00
3	4.84250	4.83625	72.5000	33.3750	143s 11½d	35.00
4	4.83875	4.83125	73.0000	33.5625	144s 1 d	35.00
6	4.84500	4.83750	73.0000	Holiday	Holiday	35.00
7	4.84125	4.83500	72.8750	33.7500	143s 7½d	35.00
8	4.83750	4.82875	71.3750	32.8125	144s ½d	35.00
9	4.84500	4.83750	71.2500	32.5000	143s 8 d	35.00
10	4.85125	4.84375	72.1250	33.0000	143s 5 d	35.00
11	4.86000	4.85250	73.1250	33.2500	143s 4 d	35.00
13	4.87375	4.86750	73.7500	33.5000	142s 6½d	35.00
14	4.87125	4.86375	74.8750	34.7500	142s 8½d	35.00
15	4.87125	4.86375	76.6250	35.2500	142s 9 d	35.00
16	4.88250	4.87375	76.5000	35.3750	142s 7 d	35.00
17	4.91250	4.90375	77.0000	35.0000	141s 8 d	35.00
18	4.91375	4.90250	77.0000	35.0000	141s 8 d	35.00
20	4.92000	4.90875	76.0000	34.8125	141s 8 d	35.00
21	4.90750	4.89625	75.0000	33.7500	141s 5 d	35.00
22	4.90250	4.89000	76.2500	34.6875	141s 11½d	35.00
23	4.91875	4.90375	76.0000	34.1875	141s 1½d	35.00
24	4.94000	4.92500	76.1250	34.1250	141s 6 d	35.00
25	4.94000	4.92500	75.5000	33.7500	142s	35.00
27	4.94750	4.93000	75.5000	33.9375	141s	35.00
28	4.93000	4.91125	74.0000	33.6875	141s 7½d	35.00
29	4.93250	4.91500	73.1250	32.9375	141s 9 d	35.00
30	Holiday			33.0625	142s	Holiday
31	4.94250	4.92000	74.5000	33.5625	142s	35.00
Av. for mo.	4.88587	.....	74.356	33.865	.....	35.00
Averages for Week						
1	4.82563	.....	76.875	.....	.....	.....
8	4.84083	.....	72.333	.....	.....	.....
15	4.86208	.....	73.625	.....	.....	.....
22	4.90646	.....	76.292	.....	.....	.....
29	4.93479	.....	75.042	.....	.....	.....

Calendar week averages: New York Silver May 4th, 73.875; 11th, 72.292; 18th, 75.958; 25th, 75.813.

(a) F.o.b. Valley quotation issued by the Code Authority for copper offered for sale in domestic market pursuant to provisions of Copper Code.

(b) Net prices at refineries on Atlantic seaboard. Quotations for May 1 to May 25, inclusive, based on Copper Code Authority's daily price; May 27 to May 31, inclusive, *E.&M.J.*

(c) Export quotations for copper are net prices at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. The c.i.f. Hamburg, Havre, and Liverpool basis commands a premium of 0.300c. per lb. above our f.o.b. refinery quotation.

Excepting "Blue Eagle" copper, the above quotations are our appraisal of the major United States markets, based on sales reported by producers and agencies. All prices are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(d) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57.

(e) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

May	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
1	32.1875	32.6250	35.5000	226.0000	221.0000	13.2500	13.4375	13.8750	14.1875
2	32.0625	32.5000	35.5000	225.0000	219.7500	13.1250	13.3125	13.7500	14.0625
3	32.2500	32.6875	35.7500	225.2500	219.7500	13.1875	13.4375	14.0000	14.3125
6					Holiday				
7	32.5625	33.0000	36.0000	224.7500	219.2500	12.9375	13.1875	13.8750	14.1875
8	32.6250	33.0000	36.0000	224.0000	218.2500	13.0625	13.3125	14.0000	14.2500
9	32.8750	33.3125	36.5000	224.7500	219.1250	13.3125	13.4375	14.1250	14.3750
10	33.1875	33.5625	36.5000	225.2500	219.2500	13.3750	13.3750	14.2500	14.4375
13	33.4375	33.8750	36.5000	225.0000	218.7500	13.7500	13.7500	14.6250	14.7500
14	33.7500	34.1875	37.0000	226.0000	219.7500	13.8125	13.8750	14.5625	14.7500
15	33.4375	33.8750	37.0000	226.2500	219.2500	14.0000	14.0000	14.7500	14.9375
16	33.7500	34.1875	37.0000	227.7500	220.7500	14.0000	14.0625	14.6875	15.0000
17	33.9375	34.3750	37.2500	229.5000	222.5000	14.1250	14.1250	15.0000	15.1250
20	33.9375	34.3750	37.0000	228.5000	221.3750	14.1875	14.2500	14.7500	14.8750
21	33.6250	34.0000	37.0000	228.5000	221.7500	14.1250	14.1875	14.6250	14.8750
22	33.9375	34.3125	37.0000	229.2500	222.6250	14.4375	14.5000	14.8125	15.0000
23	34.1250	34.5000	37.6250	231.7500	224.2500	14.5625	14.6250	15.0625	15.0625
24	34.4375	34.8125	37.7500	231.5000	223.7500	14.5625	14.6250	15.1250	15.1250
27	34.8125	35.1250	38.0000	230.5000	222.5000	14.6875	14.6875	15.3125	15.2500
28	34.2500	34.6250	37.7500	230.2500	223.0000	14.3750	14.3750	15.0000	15.0000
29	32.3750	32.8125	36.5000	228.7500	220.5000	13.6875	13.6875	14.5000	14.4375
30	32.9375	33.3125	36.5000	229.7500	221.7500	13.9375	14.0000	14.4375	14.4375
31	33.0625	33.4375	36.5000	229.0000	221.5000	14.4375	14.4375	14.6250	14.6250
Av. for month	33.344	.....	36.733	227.602	.....	13.861	13.940	14.534	14.685

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(June 1, 1935)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	19@21c.
Antimony, domestic or Chinese (duty paid), lb.	12½c.
Bismuth, ton lots, lb.	$1.10
Cadmium, lb.	65.00c.
Chromium, 97 per cent grade, lb.	88.00c
Nickel, electrolytic cathodes, lb.	35.00c.
Magnesium, 99.8 per cent, carloads, lb.	30.00c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$32.00
Quicksilver, flask of 76 lb., 100 flasks or more.	$72.00
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent. spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$15.50@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$36.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52@55 per cent	26c.
49@51 per cent	25c.
44@47 per cent	24c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$15.50
Domestic Scheelite	$15.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$26.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	3½c.
Cobalt Oxide, 70@71 per cent, lb.	$1.35
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.24
Sodium Sulphate, bulk, ton	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be	$25.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$500@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 95 per cent $BaSO_4$, less than 1 per cent iron	$5.50
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a)$4.50@ $6.00
French, 56@59 per cent	(a)$5.50@ $6.50
China Clay, f.o.b. mines ton:	
South Carolina and Georgia, bulk	$6.00@ $7.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$13.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2in.	15@30c.
2x2in.	30@50c.
2x3in.	50@65c.
3x4in.	90@ $1.25
4x6in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets gross ton	$27.00
Structural shapes, 100 lb.	$1.80
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1934	1935	1934	1935	1934	1935
January	44.188	54.418	19.382	24.584	504.644	489.207
February	45.233	54.602	20.073	24.818	503.085	487.278
March	45.875	59.048	20.278	27.380	509.259	477.635
April	45.180	67.788	19.740	30.986	515.210	483.596
May	44.226	74.356	19.276	33.865	510.510	488.587
June	45.173	.....	19.981	.....	504.721	.....
July	46.310	.....	20.512	.....	503.990	.....
August	48.986	.....	21.377	.....	506.398	.....
September	49.484	.....	21.888	.....	499.344	.....
October	52.375	.....	23.581	.....	494.019	.....
November	54.255	.....	24.257	.....	498.832	.....
December	54.390	.....	24.404	.....	494.520	.....
Year	47.973	.....	21.229	.....	503.711	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery, Electrolytic			London Spot			
	Domestic		Export	Standard		(a) Electrolytic	
	1934	1935	1935	1934	1935	1934	1935
January	7.890	8.775	6.583	32.560	28.077	35.614	31.261
February	7.777	8.775	6.341	33.072	27.175	35.969	30.244
March	7.775	8.775	6.526	32.497	28.518	35.512	31.607
April	8.173	8.775	7.328	33.006	31.231	36.038	34.763
May	8.275	8.775	7.794	32.662	33.344	35.756	36.733
June	8.594	.....	.....	32.149	.....	35.339	.....
July	8.775	.....	.....	29.707	.....	32.778	.....
August	8.775	.....	.....	28.358	.....	31.483	.....
September	8.775	.....	.....	27.541	.....	30.556	.....
October	8.775	.....	.....	26.753	.....	29.478	.....
November	8.775	.....	.....	27.233	.....	30.222	.....
December	8.775	.....	.....	27.836	.....	31.086	.....
Year	8.428	.....	.....	30.281	.....	33.319	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1934	1935	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.000	3.692	3.900	3.542	11.304	11.517	10.321	10.514
February	4.000	3.528	3.900	3.378	11.634	11.913	10.216	10.413
March	4.000	3.579	3.900	3.429	11.545	11.842	11.012	11.188
April	4.179	3.692	4.042	3.542	11.500	11.794	12.231	12.459
May	4.140	3.962	3.990	3.812	11.051	11.341	13.861	13.940
June	3.975	.....	3.825	.....	11.054	11.253	.....	.....
July	3.772	.....	3.623	.....	10.813	11.045	.....	.....
August	3.747	.....	3.597	.....	10.821	11.028	.....	.....
September	3.685	.....	3.535	.....	10.388	10.613	.....	.....
October	3.654	.....	3.504	.....	10.359	10.554	.....	.....
November	3.567	.....	3.417	.....	10.432	10.597	.....	.....
December	3.604	.....	3.454	.....	10.316	10.500	.....	.....
Year	3.860	.....	3.724	.....	10.935	11.166	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	Straits New York		Standard, Spot London	
	1934	1935	1934	1935
January	51.891	50.916	226.631	231.193
February	51.668	50.063	226.731	227.381
March	53.838	46.962	233.863	215.726
April	55.622	50.154	239.181	223.513
May	53.541	51.138	234.239	227.602
June	51.271	.....	226.875	.....
July	51.930	.....	230.381	.....
August	51.953	.....	228.114	.....
September	51.503	.....	229.888	.....
October	50.951	.....	230.587	.....
November	51.227	.....	228.602	.....
December	50.902	.....	228.178	.....
Year	52.191	.....	230.273	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.271	3.730	14.688	14.943	11.994	12.207
February	4.384	3.714	14.844	15.125	11.819	12.000
March	4.368	3.894	14.735	15.033	12.095	12.250
April	4.370	4.030	14.916	15.200	12.891	13.128
May	4.346	4.220	14.722	14.966	14.534	14.685
June	4.240	.....	14.241	14.467	.....	.....
July	4.317	.....	13.466	13.693	.....	.....
August	4.281	.....	13.682	13.756	.....	.....
September	4.049	.....	12.644	12.847	.....	.....
October	3.832	.....	12.217	12.353	.....	.....
November	3.732	.....	12.000	12.281	.....	.....
December	3.711	.....	11.730	12.016	.....	.....
Year	4.158	.....	13.657	13.890	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1934	1935	(a) 1934	(b) 1935
January	55.000	55.000	23.300	20.000
February	55.000	55.000	23.300	20.000
March	55.000	58.462	23.300	20.000
April	55.000	65.000	23.300	20.000
May	55.000	65.000	23.300	20.000
June	55.000	.....	23.300	.....
July	55.000	.....	23.300	.....
August	55.000	.....	23.300	.....
September	55.000	.....	23.300	.....
October	55.000	.....	23.300	.....
November	55.000	.....	23.300	.....
December	55.000	.....	23.300	.....
Year	55.000	.....	23.300	.....

Aluminum in cents per pound, 99 per cent grade. (a) Based on Aluminum Company's quotation. (b) Open market price.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1934	1935	1934	1935	1934	1935
January	7.198	14.111	67.538	72.760	38.000	34.000
February	7.172	14.250	72.011	72.500	38.000	34.000
March	7.545	14.250	75.472	72.500	38.000	32.846
April	7.918	14.029	75.930	72.500	38.000	32.000
May	8.465	12.712	75.577	72.135	36.538	32.000
June	7.900	.....	75.000	.....	36.000	.....
July	8.024	.....	75.000	.....	36.000	.....
August	8.514	.....	75.000	.....	36.000	.....
September	8.745	.....	74.563	.....	36.000	.....
October	9.361	.....	74.000	.....	35.038	.....
November	12.239	.....	73.283	.....	35.000	.....
December	13.730	.....	73.000	.....	35.000	.....
Year	8.901	.....	73.865	.....	36.465	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1934	1935	1934	1935	1934	1935
January	18.00	19.00	17.00	18.00	17.50	18.50
February	18.00	19.00	17.00	18.00	17.50	18.50
March	18.00	19.00	17.00	18.00	17.50	18.50
April	18.48	19.00	17.48	18.00	17.98	18.50
May	19.00	19.00	18.00	18.00	18.50	18.50
June	19.00	.....	18.00	.....	18.50	.....
July	19.00	.....	18.00	.....	19.50	.....
August	19.00	.....	18.00	.....	18.50	.....
September	19.00	.....	18.00	.....	18.50	.....
October	19.00	.....	18.00	.....	18.50	.....
November	19.00	.....	18.00	.....	18.50	.....
December	19.00	.....	18.00	.....	18.50	.....
Year	18.707	.....	17.707	.....	18.237	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.

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If You Are Lured by legends of lost mines you will be interested in "The Adams Diggings Story," published privately by Charles Allen, 1530 Mundy Ave., El Paso, Tex., price 75c. It is a tale, authenticated from various sources, of diggings so rich that one man panned 900 oz. of gold in 11½ days. Mr. Allen gives Adams' trail from the time he crossed the Gila River near San Carlos, Ariz., until he reached Hot-ta-pi-wat valley, presumably in Socorro County, N. M., where his party was massacred by Indians. But the directions are evidently incorrect, because no one, including the author, has ever been able to find the place from which the gold came in 1864.

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Safety Note. The railroads of the United States and Canada established a further safety record in 1934 of no persons killed or injured and no property damaged in the transportation of more than 300,000,000 pounds of dynamite and black powder. This is the eleventh consecutive year in which the railroads have safely transported these explosives.

•

Gold Diggers. Broadway, New York, is not the only scene of their operations. When the price of gold was pegged at $35 per ounce numerous nimble-witted men were eager to aid the householder to convert his gold into cash. Tricky scales and weights were used to turn gold buying into a profitable racket. In New Jersey, the State Department of Weights and Measures discovered clever schemes, among them the use of a penny coin as a pennyweight unit. Investigation of weights and measures throughout the state resulted in the condemnation of 400 sets of troy weights.

CONTENTS FOR JULY 1935

Volume 136....Copyright 1935....Number 7

Editorials 317

Tri-State Flood Control Cuts Mine Pumping 319
E. W. McCuskey

The Panner's Rôle in Placer Mining..... 323
J. J. Bach

A Higher Status for Engineers..... 324
C. F. Hirshfeld

Lead Mining in Southeast Missouri..... 326

Correcting Power Factor at Mine Plants.. 331
A. W. Gelbke Frank W. Gravlin

Glory-Hole Surveying at Fresnillo..... 333
James G. Traill

Wanted—An Index for Measuring the Surface of a Mineral Powder..... 336
A. J. Weinig

Activity in Camps of Southern California 343
J. B. Huttl

News of the Industry..... 347

Personal Items, Obituaries, Letters..... 359

Books 362

Equipment News 363

Summary of the Markets..... 366

Leniency. The President has signed a bill suspending for one year the law requiring that $100 must be expended annually for the development of each mining claim, provided the holder paid no Federal income tax for 1934. Debate in the House showed considerable opposition, and the decision on the part of some members to put an end to suspension after July 1, 1935. Next year claim holders will probably have to protect their holdings in the usual manner or forfeit them to more enterprising people.

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Code Costs. The total cost of administering the NRA and its 578 codes for two years is more than $93,000,000, according to figures issued by the National Industrial Conference Board, New York. Additional costs not included involve the expense of business men in formulating codes, attending hearings, and defending suits.

•

Two Million Patents have been granted by the Patent Office in Washington. No. 2,000,000 was issued on May 29. It related to automobile tires, which, by a curious coincidence, was also the subject of the millionth patent in 1910. The Patent Office was opened in 1791. It took 119 years to issue the first million patents; only 25 more to reach the 2 millionth mark.

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Regimentation. Wisconsin has passed a bill requiring restaurants to serve ⅜ oz. each of native butter and cheese with each meal costing 25c. or more. This suggests the bright idea of making it mandatory to use non-ferrous metal dishes in all restaurants throughout the United States. But the Wisconsin experiment is not succeeding in changing the habits of diners.

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